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AN ANALYSIS OF THE HERPETOFAUNA OF
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AN ANALYSIS OF THE HERPETOFAUNA
OF PRINCE EDWARD ISLAND

by Francis R. Cook 2

Ottawa, 1967

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Résumé

Cette étude des reptiles et des amphibiens de l'île du Prince-Édouard se fonde essentiellement sur des collections et sur les notes consignées sur place du 16 juin au 10 juillet 1958, du 24 au 26 avril et du 9 au 10 mai 1959.

La faune erpétologique de l'île est fort intéressante du fait que les ouvrages de l'homme (fossés, mares de carrières, réservoirs de moulin et leurs barrages) constituent surtout l'habitat de cette faune.

On y rencontre les douze espèces suivantes: *Ambystoma laterale*, *A. maculatum*, *Notophthalmus viridescens*, *Plethodon cinereus*, *Bufo americanus*, *Hyla crucifer*, *Rana clamitans*, *R. sylvatica*, *R. pipiens*, *Thamnophis sirtalis*, *Storeria occipitomaculata* et *Opheodrys vernalis*. Au cours des études effectuées sur place, on a recueilli des collections considérables de tous les amphibiens et, pour chacune d'elles, nous présentons une analyse de leurs variétés, des données résultant des notes prises sur place et des comparaisons faites avec les études déjà publiées. On donne les variétés de 31 spécimens de *Thamnophis sirtalis*, de *Storeria occipitomaculata* et de quatre *Opheodrys vernalis*, mais les seuls serpents capturés au cours de l'expédition sont deux spécimens de *Thamnophis*.

Trois espèces, *Rana septentrionalis*, *Rana palustris* et *Coluber constrictor*, que d'autres auteurs ont consignées avant nous dans la faune de l'île du Prince-Édouard en sont éliminées, faute de preuves ou en raison de la possibilité d'une identification erronée.

Aux fins de l'étude de la zoogéographie de l'île du Prince-Édouard, la faune erpétologique maritime est divisée en cinq groupes dont les espèces mentionnées présentent certaines similarités de distribution. Les douze espèces que l'on trouve dans l'île sont les plus répandues dans les provinces Maritimes où elles abondent généralement. L'hypothèse selon laquelle ces espèces auraient atteint l'île par une langue de terre est admise. Toutefois, l'absence des conditions indispensables en matière d'habitat ou de climat explique peut-être pourquoi l'on ne trouve pas dans l'île certaines, voire la totalité, des treize espèces communes sur le continent, la plupart desquelles se seraient répandues dans les provinces Maritimes après la submersion de la langue de terre.

Introduction

Studies of the intraspecific variation in amphibians and reptiles and analysis of the herpetofauna of a single province have rarely been made for Canada. Prince Edward Island, because of its small size and paucity of species, has seldom been visited by herpetologists, and museums have contained few specimens collected from it. This paper is based primarily on the results of field studies for the National Museum of Canada in 1958 and 1959, which were designed to survey the herpetofauna of this province in detail, and on a preliminary survey by J. S. Bleakney in 1953. It presents analysis of the variation in adult specimens of the twelve species recognized for the Island, and includes field notes on breeding, habitat, and abundance. As it was considered important to base the analysis on fresh specimens, no effort was made to locate and include the few prior museum collections with the exception of snakes, of which only two specimens were taken during the above field studies. The inadequateness of the snake sample has been considerably relieved by the donation to the National Museum of specimens collected in 1964 and 1965 by M. L. H. Thomas, while the final version of this manuscript was in preparation. All known published references to each species on the Island have been included.

Although this paper is not intended as a field guide and therefore keys and capsule descriptions are omitted from the text, each species, except the Smooth Green Snake for which no Prince Edward Island specimens were available until recently, is illustrated; reference to the illustrations and descriptions of variation should readily identify any Island species. If any specimens that cannot be recognized are discovered, the finder is urged to forward them (preserved in 5–10% formalin) to the National Museum of Canada for examination. In addition, any snake specimens from the Island would be appreciated as our present collection is inadequate.

The previous literature on the herptiles of Prince Edward Island is sparse and may be summarized briefly. J. T. Mellish (1876) was probably the first author to publish on the Island herpetology, but his paper contained a discussion only of the snakes. Francis Bain (1890) included a few remarks on the species of both reptiles and amphibians in his general work on the natural history of the Island. Phillip Cox and Roy McLean Vanwart collected there in the late 1890's, and the species taken on their trip are noted in later papers on the Maritimes, Gaspé, and Canada by Cox (1899*a*, 1899*b*, 1899*c*, 1903, 1907). Fowler (1915) made incidental mention of specimens in the Academy of Natural Sciences of Philadelphia collection. The first complete list of the amphibians was published by Blythe Hurst, Sr. (1944), but it apparently was based mostly on the papers of Cox for the species to be included and on those of other authors for descriptions of them. Later, Hurst

(1946) found and recorded an additional species. Prince Edward Island was occasionally included in the range summaries of R. C. Mills (1948) and E. B. S. Logier (1952). J. S. Bleakney (1954) listed the six amphibian species collected on his brief visit to the Island in 1953. The first 'spot' distribution maps which included Prince Edward Island specimens were presented by Logier and G. C. Toner (1955, 1961) and Bleakney (1958). Unfortunately, both perpetuated some apparently erroneous reports of earlier authors. These are discussed in this paper under 'Rejected Records.' The original version of this paper was written as a Master's Thesis for Acadia University in 1960, and subsequently one paper (Thomas, 1965) has appeared giving data on specimens of three species of snakes collected in Prince County in 1964.

The Prince Edward Island herpetofauna is considered here to consist of nine amphibians and three snakes. A systematic list follows.

Class: Amphibia

Order: Caudata

Family: Ambystomatidae

Ambystoma laterale Hallowell — Blue-spotted Salamander

Ambystoma maculatum (Shaw) — Spotted Salamander

Family: Salamandridae

Notophthalmus viridescens viridescens (Rafinesque) — Red-spotted Newt

Family: Plethodontidae

Plethodon cinereus cinereus (Green) — Red-backed Salamander

Order: Salientia

Family: Bufonidae

Bufo americanus americanus Holbrook — American Toad

Family: Hylidae

Hyla crucifer crucifer Wied — Northern Spring Peeper

Family: Ranidae

Rana clamitans melanota (Rafinesque) — Green Frog

Rana sylvatica Le Conte — Wood Frog

Rana pipiens Schreber — Leopard Frog

Class: Reptilia

Order: Serpentes

Family: Colubridae

Storeria occipitomaculata occipitomaculata (Storer) — Northern Red-bellied Snake

Thamnophis sirtalis pallidula Allen — Maritime Garter Snake

Opheodrys vernalis vernalis (Harlan) — Eastern Smooth Green Snake

Acknowledgments

The author is indebted to the National Museum of Canada for financing the field research work on which this report is based, and for the loan of the entire collection while an earlier version of the manuscript was being prepared; and to Acadia University, Wolfville, N.S., for the facilities and space provided during the preparation of the initial manuscript. This manuscript was accepted in May, 1960, as partial fulfilment of the requirements for the degree of Master of Science in Biology.

Thanks are due to E. B. S. Logier and W. B. Scott for the loan of Royal Ontario Museum specimens of *Storeria* and *Thamnophis*; to Blythe Hurst, Jr. for permission to examine his father's notes; to Roger Conant, Sherman Minton, and Thomas Uzzell for correspondence on the problem of the *Ambystoma jeffersonianum* complex; to James E. Böhlke, Department of Ichthyology and Herpetology, the Academy of Natural Sciences of Philadelphia, for the loan of specimens; to Martin L. H. Thomas who generously donated 31 snakes, taken in Prince County in 1964 and 1965, to the National Museum of Canada, together with colour notes, colour slides, and measurements in some cases, so that they would be available for inclusion in this report; and to the many people on Prince Edward Island who contributed observations in the field.

In particular, the writer would like to express his appreciation to Dr. J. Sherman Bleakney for his encouragement, advice, and criticism during field studies and during the preparation of the earlier version of this paper; to John Tottenham who painstakingly prepared the illustrations of ten of the species from preserved specimens; and to Joyce Crosby Cook who prepared the graphs and map.

Materials and Methods

Field-work on Prince Edward Island was carried out by the author and by Dr. J. S. Bleakney during the periods June 16 to July 10, 1958; April 24 to 26, and May 9 to 10, 1959. Field bases were at Cavendish and Summerside, and collecting localities were reached by car. During the course of these field studies every effort was made to examine as much of the province as possible and to collect specimens in all available habitats. Figure 1 shows the collecting stations from which specimens were obtained, and therefore it also depicts the area examined. Because of an extensive interlacing network of roads, virtually all habitats were accessible by car.

An effort was made to obtain series of all species discovered, and notes on abundance, habitat, and weather conditions were made for each collection. Specimens were obtained mainly by dip-net or by hand, although a small seine was occasionally employed for catching newts and tadpoles. In general, pond habitats provided the majority of collections, but streams, millsites, and other areas offering suitable conditions and cover for herptiles were searched, often with success. Collecting was done at all hours, but mainly during the day in the summer and at night in the spring.

Whenever possible, local inhabitants were queried on the abundance and kinds of reptiles and amphibians in their respective areas. This procedure

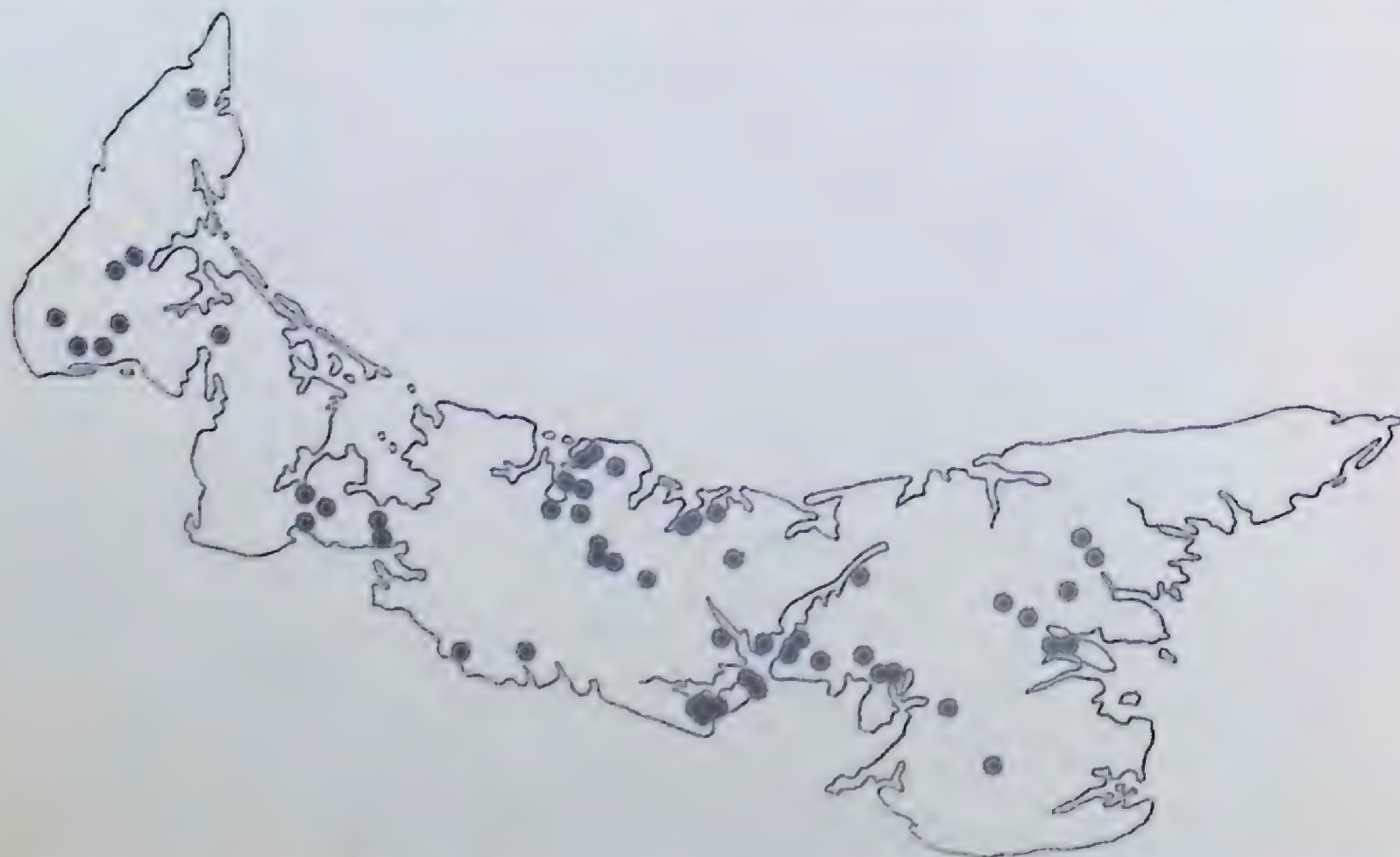


FIGURE 1—Outline map of Prince Edward Island. Solid circles represent collecting stations in 1958 and 1959.

was occasionally useful for finding likely collecting spots, but it rarely produced any but the most general information as to species and their abundance.

All specimens, with the exception of tadpoles and larvae, were killed with ether and were sexed, then measured, and finally preserved in formalin. A 5 per cent solution was initially used for all herptiles, with transfer of specimens after twenty-four hours to 3 per cent solution for amphibians and 5 per cent for snakes. Tadpoles and larvae were placed immediately into 3 per cent formalin.

The measurements taken were:

- Frogs — Body length (snout to vent)
— Tibia length
- Salamanders and snakes — Total length (snout to tip of tail)
— Body length (snout to mid-vent)

All measurements for frogs and salamanders were taken in millimetres using a plastic 152 mm rule for body and total lengths and vernier calipers for tibia lengths. Snakes were measured in inches with a metal tape. The importance of taking measurements from freshly killed, relaxed specimens cannot be over-emphasized, as measurements from preserved material are often inaccurate owing to shrinkage and distortion of specimens.

Scale counts in snakes followed the methods suggested by Schmidt and Davis (1941), except in the case of ventral scale counts where the method proposed by Dowling (1951*a*) was used, and in dorsal scale row formulae in *Thamnophis* which followed Dowling (1951*b*).

Sex determination in amphibians was based largely on secondary sexual characters, although in a few cases this was checked by dissection. Sex was verified by dissection in all snakes except a few obvious females.

The collection was augmented by material from the National Museum of Canada collected by Dr. J. S. Bleakney during the period June 18 to 27, 1953, for which measurements of freshly killed specimens were available. Also included in this study are snake specimens in the National Museum of Canada and the Royal Ontario Museum, and snakes collected by M.L.H. Thomas of the Fisheries Research Board, Eglerslie Sub-Station, P.E.I., which have been deposited in the National Museum of Canada.

A total of 923 amphibians, 839 adults and 84 immatures, of nine species, were examined for this study. Of this total, 824 were collected during field-work in 1958 and 1959. Forty-two snakes of three species were available, thirty-one of these from M. L. H. Thomas. Only two snakes were taken on field surveys in 1958 and 1959.

The results of the analysis of morphological variation, as well as comparison with published accounts of these species and notes on their life-histories on the Island, are reported under 'Species Accounts.' No comparison with collections from the nearest mainland populations was attempted as comparative material is considered inadequate at the present time. It is hoped it will be available at a later date. Comparisons here are with published data on the nearest mainland populations.

Description of Area

Prince Edward Island has often and aptly been termed the 'million-acre farm' and the 'garden of the Gulf.' About sixty per cent of its total area, with as much as seventy-two per cent in some parts, is devoted to agriculture.

The Island is crescent-shaped, 145 miles in length, and about 2,100 square miles in area. Situated in the southern part of the Gulf of St. Lawrence, it varies in distance by as little as nine miles to as much as forty miles from New Brunswick and northern Nova Scotia.

Its location at latitudes $45^{\circ}57'N$ to $47^{\circ}N$ results in a cool, temperate climate with freezing winters and moderately warm summers. The average date of the last frost at Charlottetown is May 13, but this may vary two weeks either way. The autumn frost is delayed until mid-October by the Island's proximity to the sea. Precipitation is fairly even throughout the year and averages forty-three inches annually.

The Island is of generally low relief and gentle topography, with low summits less than 500 feet above sea-level. The short slopes to the sea or rivers give most areas adequate drainage. Geologically, the Island consists of a more or less uniform permo-carboniferous bed-rock, slightly folded, eroded, and overlain with deposits of the Pleistocene age, which forms the basis of the present soils — red and sandy loams.

With as much as seventy-two per cent of the land cleared in some areas, and with most of the forested area having undergone selective cutting, little of the original forest remains. It appears that the forest was predominantly broad-leaved, with sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), and yellow birch (*Betula lutea*) having had a wide distribution. The Island is classified by Rowe (1959) as a section of the Acadian Forest Region.

The vegetation has been discussed in detail by Erskine (1961), and most of the above summary of the Island has been taken from his excellent text. Additional comments follow Rowe (1959).

Herpetologically, a remarkable aspect of the province that became evident early in the course of field-work is the extensive utilization of man-made habitats by reptile and amphibian species. These habitats may be characterized as follows:

Millponds

The Island is extensively cut by streams and a few rivers. For decades these have been dammed to provide the necessary power for sawmills and grist mills. The general impression is that almost every stream has, or has had, a dam across it, creating a sizable pond. Owing to extensive lumbering



FIGURE 2—Millpond, 1.2 miles west on Hwy. 3 of Millview, Queens County, July 3, 1958. This photograph shows the pond shortly after its dam had broken. This was later repaired, restoring the pond.



FIGURE 3—Millsite at Granville, Queens County, July 1, 1958. The rotting dam and scattered boards at this site provided optimum habitat for *Plethodon c. cinereus*.

the water table and, consequently, the level of streams have been lowered. This has diminished the amount of water power available and, coupled with the advent of gasoline-powered saws, and so on, has resulted in the neglect of most of the original dams. As an inevitable result, many of these log dams have become rotted and washed out, leaving a wide silt meadow transversed by a narrow stream where a large and biologically productive pond formerly existed (Figure 2). Where they are still intact, these ponds and their borders provide ideal habitat for *Rana clamitans*, *Rana pipiens*, and *Bufo americanus*. *Notophthalmus viridescens* has also colonized many of them. *Thamnophis sirtalis* undoubtedly finds them good hunting grounds and utilizes the cover provided by the logs and boards which mark their margins, particularly at the millsites themselves (Figure 3). The dams provide an optimum habitat of moist rotting wood for *Plethodon cinereus*. In fact, the only collections of this species during the survey came from in and around these structures. These salamanders may have survived the massive destruction of the surrounding forest largely because of this man-made substitute habitat. Fortunately, a dam reconstruction program is in progress which will ensure the continued survival of at least some of these ponds.

Quarry Ponds

Throughout the Island numerous roadside pits have been excavated to satisfy the need for road fill (Figure 4). Most of these have flooded, thus forming shallow ponds ideal for amphibians. Species utilizing such ponds during spring breeding are *Bufo americanus*, *Hyla crucifer*, *Rana pipiens*, *Ambystoma*



FIGURE 4—Large quarry pond, 3.3 miles south on Hwy. 5 of Bridgetown, Kings County. This pond had the largest concentration of *Notophthalmus v. viridescens* found on the Island; it was also utilized by most other amphibian species.

maculatum, and *Ambystoma laterale*. Permanent residents are *Rana clamitans* and *Notophthalmus viridescens*. Occasional adult *Rana pipiens* remain along the margins of these ponds, at least until mid-July. Tadpoles and *Ambystoma* larvae are abundant. Within a few years after their creation, the ponds tend to fill in around the edges with alder bushes. Because soil and vegetation gradually accumulate and fill in these ponds, they have a relatively short expectancy as ideal habitat.

Roadside Ditches

As a result of recent road improvement, deep ditches are present on both sides of most roads. In the spring, these fill, and some water remains in them until early July at least. Because of the ditching, many low surrounding areas that formerly flooded in the spring and provided temporary ponds for early-breeding amphibians now rapidly drain off. Many species have responded to the new situation by transferring breeding activity to the ditches. These include *Rana sylvatica*, *Hyla crucifer*, *Bufo americanus*, *Rana pipiens*, *Ambystoma laterale*, and *Ambystoma maculatum*.

In addition to the three major man-created habitats described above, some naturally occurring ponds, small artificial ponds, and flooded low areas are available for utilization by breeding amphibians. Below the YMCA Camp at Rocky Point there are two ponds, separated from the sea by only a narrow strip of sand beach, where *Rana sylvatica*, *Rana pipiens*, *Hyla crucifer*, and *Bufo americanus* are common, and doubtless other species utilize the area as well.

One of the most interesting artificial habitats found during the survey was 'Dead Man's Pond' in the centre of Charlottetown's Victoria Park. It illustrates especially well the ability of some species to survive despite the mass modification of habitat by man. This steep-sided pond has sparse vegetation, but a heavy annual litter of dead leaves covers the bottom. The surrounding area is cleared parkland, utilised for playing fields and playgrounds. During the summer the park literally swarms with humanity. Yet in the spring, *Rana sylvatica* and *Rana pipiens* were collected there, and the eggs of both *Ambystoma laterale* and *Ambystoma maculatum* were abundant.

Species Accounts

Ambystoma laterale Hallowell

Blue-spotted Salamander

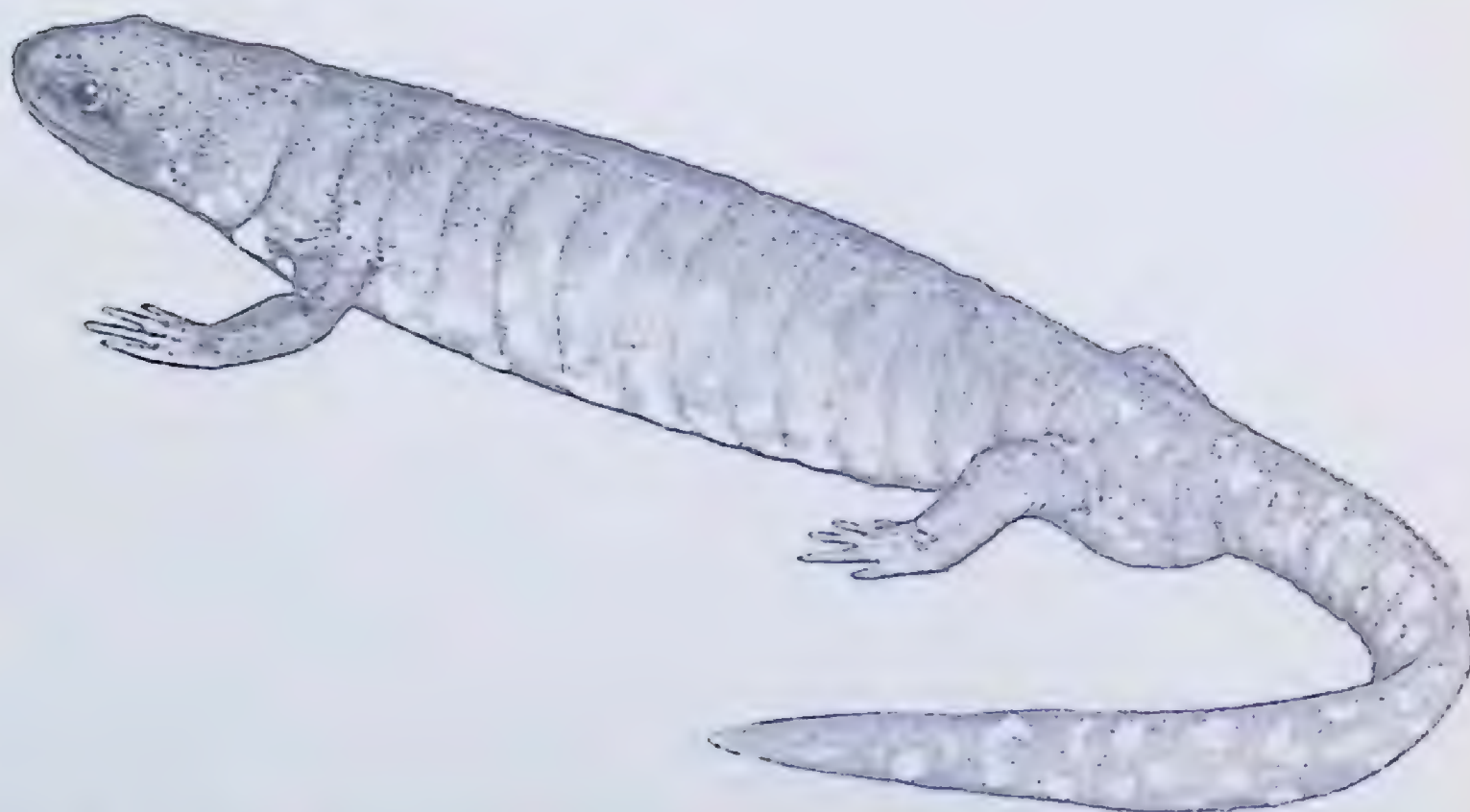


FIGURE 5—Blue-spotted Salamander, *Ambystoma laterale*. NMC 3943-11. Male. Total length 121 mm.

VARIATION

Forty-eight adults and two immatures were examined. All adults were collected during the spring breeding period.

Body length. This ranged from 50 to 69 mm, mean 63.6 mm, in 39 adult males, and from 62 to 71 mm, mean 65.9 mm, in 9 adult females (see Figure 6).

Total length. The largest specimen was 142 mm and the smallest adult was 95 mm. These specimens had body lengths of 68 and 50 mm respectively. The largest specimen by body length, 71 mm, had a total length of 137 mm. Two immatures had total lengths of 63 and 59 mm compared with body lengths of 35 and 45 mm respectively; in the latter specimen only a stub remnant of tail was present. Total length is of little value for comparing specimens of this species because of the frequency of tail breakage and subsequent regeneration. The latter can be discerned with certainty only in the most extreme cases.

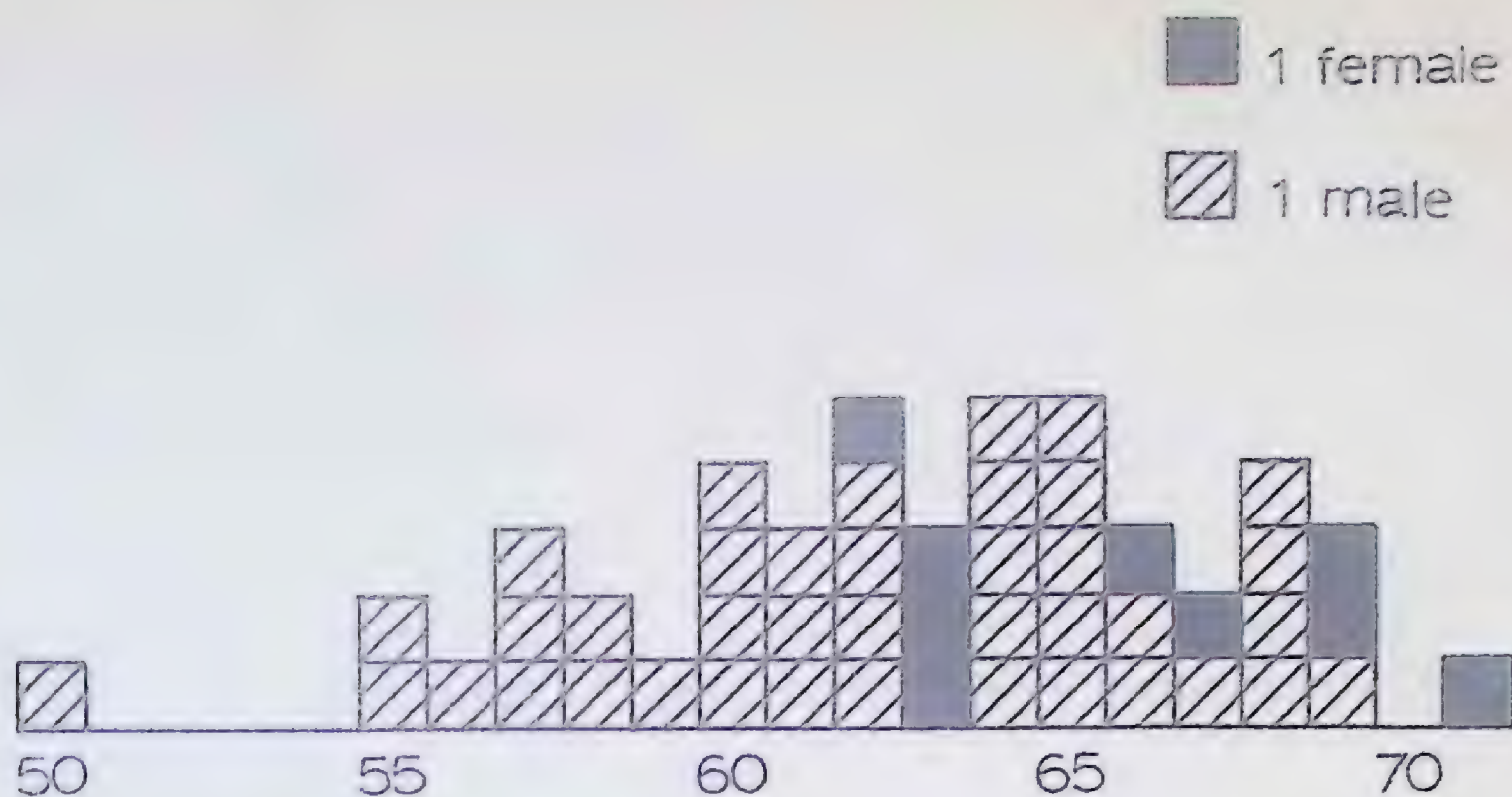


FIGURE 6—Histogram of body length in *Ambystoma laterale*.

Tail/total ratio. Variation of the ratio was between 0.53 and 0.42. Specimens with obviously incomplete tails were not included, but the greater part of the remaining variation is doubtless due to varying stages of regeneration, rather than to any genetic factor.

Costal grooves. Apparently there is no standard technique for counting costal grooves in ambystomids. In this study grooves were counted as close to the mid-line as possible, including one over the front leg and one over the hind leg, as suggested for *Ambystoma* by the studies of Highton (1957). Counts by this method were 14 grooves in 48 per cent of the specimens and 15 in 52 per cent. The number of trunk vertebrae should be one more than the count obtained if the same relationship exists between costal grooves and vertebrae as found by Highton for other *Ambystoma* species. Comparison of counts with X-ray photographs of specimens was beyond the scope of the present study, but these photographs would be necessary to validate this conclusion.

An alternate method, outlined by Logier (1952, p. 67), was also used. In this procedure the grooves were counted along the lower side between the front and hind legs. Counts were 12 (38%), 13 (56%), and 14 (6%).

Appressed limbs. When the front and hind limbs were pressed toward each other along the sides of the body, the toes touched or overlapped in 22 males and failed to touch in 17. The toes never overlapped by more than one costal groove, nor failed to touch by more than one. In nine females the toes always failed to touch by two, or slightly more, costal grooves. Because of formalin preservation these relationships could be only approximated, as the limbs of many specimens were fairly rigid.

Colour and pattern. Unfortunately, no colour notes were taken at the time of collection, and specimens were subjected to a year in formalin before close examination. As Bishop (1941, p. 84) and others have noted, there is a tendency in this species not only for the colour to fade in preservation but also for the markings to become more obscure or to be lost entirely.

The ground colour in preserved specimens varies from almost black to grey-blue above, with a lighter venter. On most of the specimens the once blue flecking, blotching, and spotting is visible to a greater or lesser extent as white patches on the belly, chin, sides, and, more rarely, on the tail. These markings are often relatively large and usually irregular in shape. They are most clearly visible along the lower edge of the sides and on the venter. Two specimens appear to be unmarked but likely represent only an extreme faded condition.

COMPARISON

The fact that two similar, dark, blue-spotted salamanders have been confused under the name *Ambystoma jeffersonianum* was pointed out by Minton (1954) in a study of the complex in Indiana. In his paper the name *Ambystoma laterale* was revived for northern Indiana populations, and their differences from southern populations were defined. The ranges of *A. jeffersonianum* and *A. laterale* in the remainder of eastern North America could not be defined at that time, except for a few general statements. Conant (1958) and Logier and Toner (1961) recognized Minton's separation but gave the ranges of the two species together on a composite map.

The Prince Edward Island populations are not typical in all respects to either species defined by Minton (1954). In adult body length the range of 50 to 71 mm is within that of *A. laterale* (45 to 75 mm) and below that of *A. jeffersonianum* (70 to 101 mm). The tail/total length ratio of 42 per cent to 53 per cent is within that of *A. jeffersonianum* rather than *A. laterale* (38% to 47%). The longest specimen in total length is 142 mm compared with 127 mm given for *A. laterale* and 209 mm for *A. jeffersonianum*. Measurements obtained in this study were taken from snout to mid-vent of fresh specimens and are not strictly comparable to Minton's data, in which measurements were made from snout to posterior angle of the vent in preserved specimens. However, remeasurement of Prince Edward Island specimens by Minton's method, after they had been two years in preservative, provided figures very similar to the original measurements, because the length gained by measuring to the posterior angle of the vent was approximated by the loss due to shrinkage caused by the preservative.

Minton gave costal groove counts for *A. laterale* of 11 (4.5%), 12 (55.5%), and 13 (40%) and for *A. jeffersonianum* of 12 (31.6%), 13 (57.9%), and 14 (10.5%). Although he did not state his method of counting in his paper, it was "to include all grooves between the insertions of the limbs and the branch of the last inguinal groove unless it is a very short spur less than about 10% of the length of the groove from which it arises. [He did] . . . not count the groove above the insertion of the forelimb" (PC: Sherman A. Minton, Jr., January 31, 1961). Neither method used here is exactly comparable to Minton's, but the indication is that Prince Edward Island specimens have a slightly higher average count than that given for *A. laterale*, a count that approaches that given for *A. jeffersonianum*.

The appressed limbs never overlapped more than one costal groove in the male, an *A. laterale* character. In *A. jeffersonianum* the overlap is always more than 1½ costal grooves.

The colour and pattern are closer to those described for *A. laterale*. The distinctiveness in colour of the two species has been stressed by Minton. *A. laterale* is darker, with heavier and larger flecking (sometimes referred to as spots), while *A. jeffersonianum* is paler, with finer and less conspicuous flecking. Though most Prince Edward Island specimens (in preservative) are not so vividly marked as the *A. laterale* figured by Conant (1958, Plate 34) and Minton (1954, Figure 26), they resemble these more than they resemble *A. jeffersonianum*.

On the basis of general agreement in size, coloration, and appressed limbs, the Prince Edward Island specimens are assigned to *Ambystoma laterale* as defined by Minton (1954). They differ from *A. laterale* of Indiana in having longer tails and in having probably a higher average costal groove count. The blue flecking may be less pronounced.

It is interesting to note that more than a half-century ago the early New Brunswick herpetologist, Phillip Cox, recognized the Maritime population as *A. laterale*, although he treated it only as a subspecies or variety of *A. jeffersonianum* (Cox, 1899c, 1907).

Since the original examination of this material, an exhaustive study and evaluation have been made of this complex throughout its range by Thomas M. Uzzell, Jr. His study has greatly increased our knowledge of variation in the complex and has confirmed the assignment of Prince Edward Island specimens to *A. laterale* (Uzzell, 1962, 1964). No specimens identifiable with the hybrid type defined by Uzzell (1962, 1963, 1964) were found in this collection.

FIELD NOTES

June 16 – July 10, 1958. *Ambystoma* larvae were numerous in small quarry ponds and ditches. Presumably these were mixed populations of this species and *A. maculatum*. Only one transformed individual was taken, on July 6, under the base of a rotting tree stump on the bank of a quarry pond.

April 24 – 26, 1959. This collecting trip coincided closely with the beginning of the amphibian breeding season. Two series were obtained, and a single specimen was taken at an additional locality. The species was remarkably abundant here, compared with most other Eastern Canadian localities where the writer has collected it. The lack of bottom litter or appreciable amounts of vegetation in ponds where series were obtained contributed to the impression of remarkable abundance; individuals were exceptionally conspicuous. Spermatophores of this and/or the following species were plentiful. No eggs were collected the first night, but one collection was made on April 25.

Logier (1952, p. 65) notes that breeding takes place in early April in southern Ontario. It is probable that the later breeding time observed for the Prince Edward Island population is due to the fact that spring is later by two or three weeks.

May 9 – 10, 1959. Adults were seen only occasionally, although eggs were abundant in many ponds. The short breeding period had apparently been completed. The eggs were deposited singly or, rarely, in small clusters of up to six, often under leaves or other bottom cover.

Bleakney (1957) has reviewed the reports of the *A. jeffersonianum* complex depositing eggs singly or in small clusters and gives three localities for this habit in New Brunswick and Quebec. This habit has been previously reported in the Chicago area (Still, 1954) and in New York State (Bishop, 1941). Minton (1954), in defining differences between *A. jeffersonianum* and *A. laterale*, did not describe the egg-laying habits of either species. The localities for single eggs or small clusters of eggs are the northern and western portions of the range, areas which may be pure *A. laterale*, indicating that this habit may be characteristic of it, while *A. jeffersonianum* may lay only the larger egg masses typically described for species of this complex.

From the field data gathered, this species is probably much more abundant on Prince Edward Island than on the Nova Scotia mainland, where it appears to be of only scattered occurrence.

SPECIMENS EXAMINED*

PRINCE COUNTY. 3792. 3 $\frac{1}{8}$ mi. sw. of O'Leary, July 9, 1958 (1); 3943. 1.5 to 1.8 mi. s. of Grand River, April 24, 1959 (29); 3976. 1.5 to 1.8 mi. s. of Grand River, May 9, 1959 (2). QUEENS COUNTY. 3950. 1.8 mi. w. on Hwy. 3 of Millview, April 25, 1959 (1). KINGS COUNTY. 3961. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (17).

LITERATURE RECORDS

Hurst (1946) was the first to record this species from the Island, citing two specimens, one from Brackley Beach, Queens County, as *Ambystoma jeffersonianum*. Bleakney (1954) drew attention to this record, and it was the basis for inclusion of the species on Prince Edward Island by Logier and Toner (1955, 1961) and Bleakney (1958). Cox (1899b) notes that he did not observe the species on Prince Edward Island.

Ambystoma maculatum (Shaw)

Spotted Salamander

VARIATION

Of the 27 adults examined, 26 were taken from breeding ponds in the spring and one was collected in the summer.

Body length. Twenty-one males varied between 60 and 83 mm, mean 70.0 mm, and six females had extremes of 73 and 84 mm, mean 80.7 mm.

Total length. The smallest example was 117 mm and the largest 174 mm. All tails appeared to be complete.

Tail/total ratio. In the majority of specimens this ratio exceeded 0.5.

Costal grooves. Counts by the Highton method described under *A. laterale* were 13 (89%) and 14 (11%). Counts by the method given by Logier (1952, p. 67) were 11 (85%) and 12 (15%).

*Unless otherwise specified, numbers in italics refer to National Museum catalogue numbers. Numbers in parentheses refer to number of specimens.

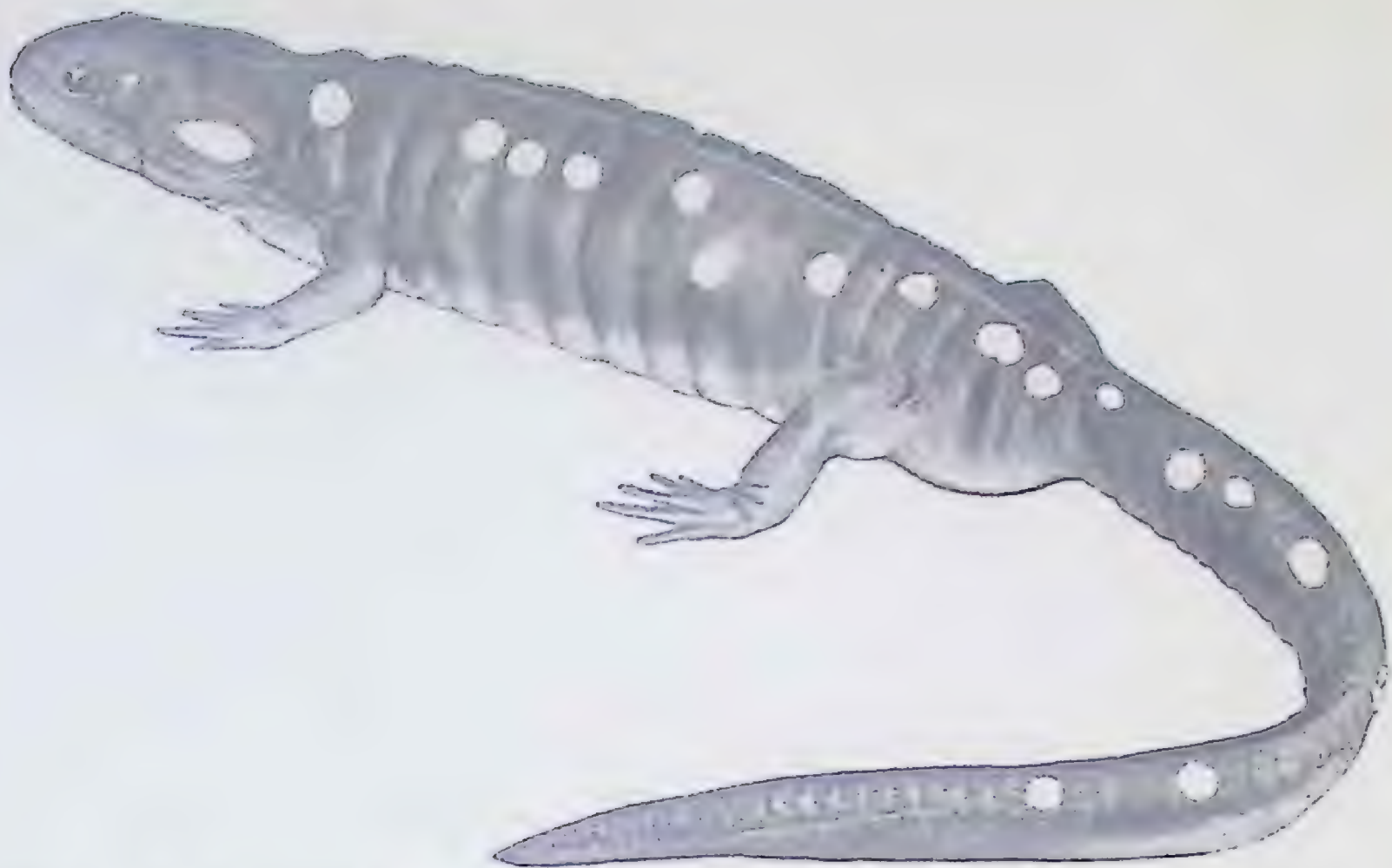


FIGURE 7—Spotted Salamander, *Ambystoma maculatum*. NMC 3942-1. Male. Total length 149 mm.

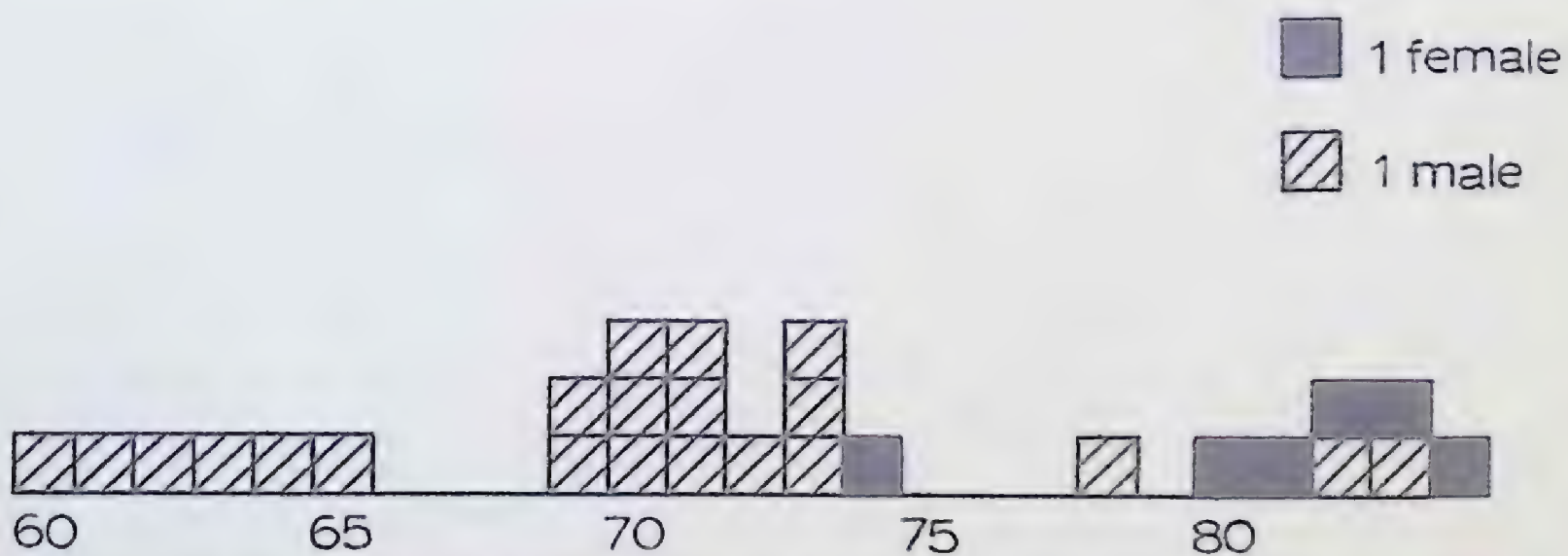


FIGURE 8—Histogram of body length in *Ambystoma maculatum*.

Colour and pattern. All specimens were more or less uniform in ground colour: black above and grey below. The large, round dorsal spots were yellow or orange-yellow in life. Three counts of these spots were taken: head, trunk, and tail. For spot-counting, the division between the trunk and the tail was defined as the costal groove directly over the hind legs. Head spots varied from 2 to 7, trunk spots from 4 to 24, and tail spots from 5 to 29. The total number of spots ranged from 19 to 59. One specimen (NMC 3784, female) was high in all categories, with 7-23-29 = 59 count. The mean spot numbers were: head 3.7, trunk 12.4, tail 12.9, and total 29.9. There were usually a few spots (1 to 4) on the upper surface of each limb. Three specimens showed light flecks scattered on the sides, chin, and upper surfaces of the hind legs. The only other *A. maculatum* seen by the

author which exhibited this addition to the normal pattern was a live adult from Wolfville, N.S., in which flecks similar in size and distribution were a vivid light blue. It is likely that the flecks of the three Prince Edward Island specimens were this colour in life.

COMPARISON

Bishop (1941) has reported the variation of *A. maculatum* in New York State material. He noted that females were a little smaller than males. This is not demonstrated by the Prince Edward Island sample, in which males have a mean body length of 70.0 mm and females 80.7 mm. Bishop recorded variation in number of spots as: head 4 to 9, trunk 13 to 20, and tail 6 to 19, with averages of 6, 17, and 11 respectively. Apparently Prince Edward Island specimens have fewer spots on the head (2 to 7, mean 3.7) and trunk (4 to 24, mean 12.4), but more on the tail (5 to 29, mean 12.9). Total spotting for New York material varied from 24 to 45 compared with 19 to 59 in Prince Edward Island specimens. Bishop also noted that males have less variation in total spot number (30 to 38) compared with females (24 to 45). The Prince Edward Island sample shows a much larger variation for males (19 to 40) and females (19 to 59). No real sexual dimorphism in spot counts seems to exist.

FIELD NOTES

June 16 – July 10, 1958. As noted under description of the preceding species, *Ambystoma* larvae were numerous in quarry ponds and ditches. One transformed individual, an adult female, was taken on July 9 from the inside of a rotting stump on the grassy edge of a millsite.

April 24 – 26, 1959. Adults were collected along with *A. laterale* in temporary ponds but were apparently less abundant than the latter species. This could have been due to a slightly later breeding season for *A. maculatum*, as noted by Logier (1952, p. 68) in southern Ontario. This is substantiated by the fact that no *A. maculatum* egg masses were seen during this trip, although eggs of *A. laterale* were common.

May 9 – 10, 1959. Egg masses were noted in ponds and ditches. The eggs of *A. maculatum* are laid in large masses, in contrast to the single eggs and small clusters laid by *A. laterale*. The large masses are usually exposed to view on the pond bottom, attached to grass or other plant stems, whereas those of *A. laterale* are often attached to the undersides of leaves and other debris of the pond bottom. A few adults were seen.

Bleakney collected an old egg mass on June 20, 1953, at Bay Fortune, Kings County.

On the basis of observations and collections, this species is common throughout the Island.

SPECIMENS EXAMINED

PRINCE COUNTY. 3784. Glenwood, July 9, 1958 (1); 3942. 1.5 to 1.8 mi. s. of Grand River, April 24, 1959 (9); 3945. 1.5. to 1.8 mi. s. of

Grand River, April 25, 1959 (1). KINGS COUNTY. 3960. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (12); 3966. 0.6 mi. e. of Roseneath, April 26, 1959 (3); 3989. 0.6 mi. e. of Roseneath, May 10, 1959 (1).

LITERATURE RECORDS

Cox (1899b) stated that this species was "common in the maritime provinces," presumably a statement meaning to include Prince Edward Island. In a later publication (1907) he specifically stated "P.E. Island (Vanwart and Cox)." Cox referred to the species as "*Amblystoma punctatum* Linn. Great Spotted Salamander." Hurst (1944) commented, "Our commonest species [of salamander] according to the writer's observation." Mills (1948) and Logier (1952) included Prince Edward Island in their range statements for the species. Logier and Toner (1955, 1961) cited a specimen in the Royal Ontario Museum collection from Ellerslie, Prince County. Bleakney (1958) plotted two localities, based on his collection of eggs from Bay Fortune and on Logier and Toner's record.

Notophthalmus viridescens viridescens (Rafinesque)

Red-spotted Newt

VARIATION

Individuals numbering 151 were examined.

Body length. Sixty-two males varied from 43 to 59 mm, mean 50.3 mm, and 87 females from 42 to 64 mm, mean 52.1 mm (Figure 10). Two immatures (efts) measured 32 and 35 mm.



FIGURE 9—Red-spotted Newt, *Notophthalmus v. viridescens*. NMC 3733-55. Male. Total length 96 mm (above). NMC 3733-35. Female. Total length 99 mm (below).

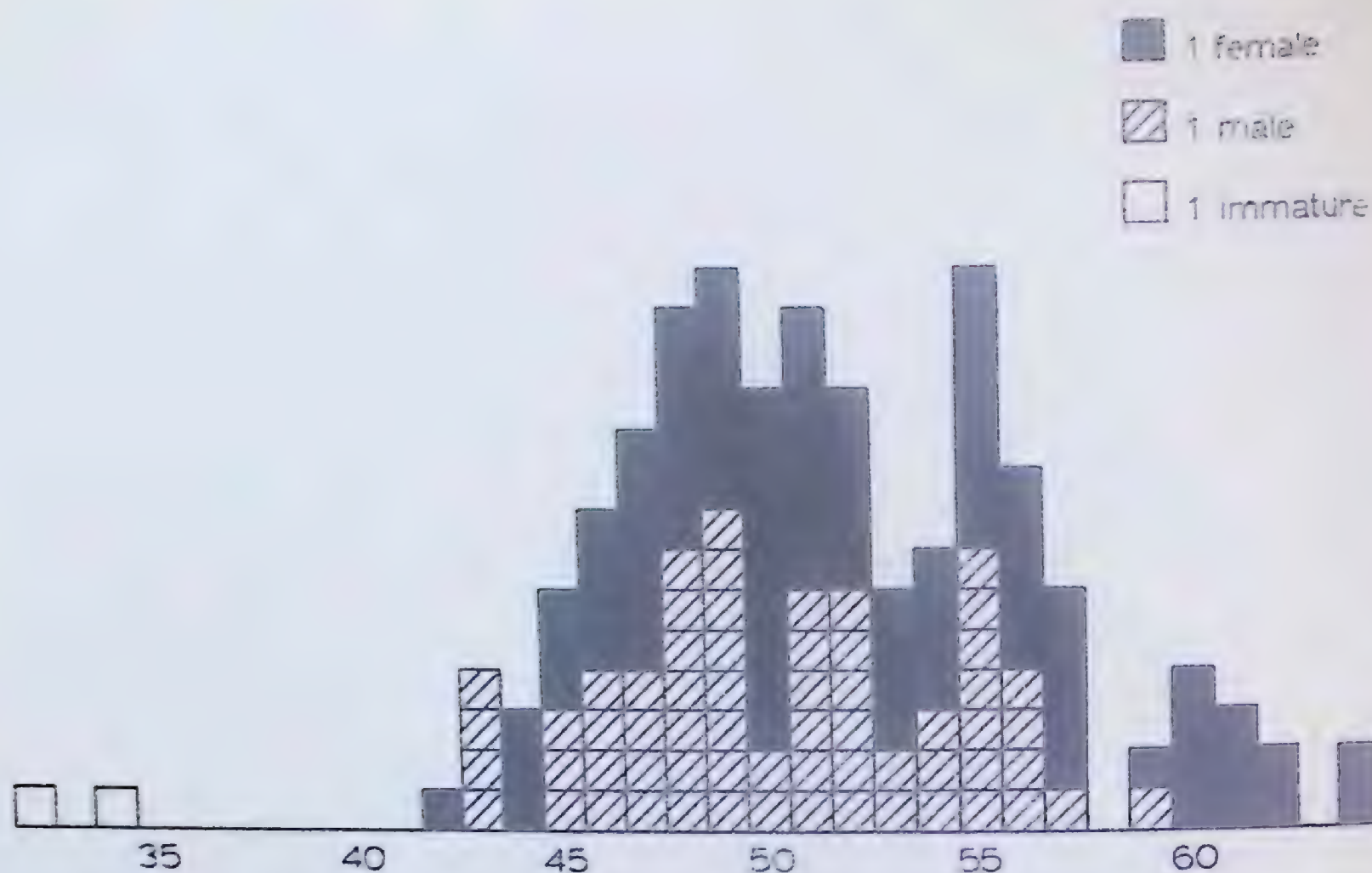


FIGURE 10—Histogram of body length in *Notophthalmus v. viridescens*.

Total length. In adults, the variation was from 81 to 137 mm for females, mean 109.8 mm, and from 86 to 131 mm for males, mean 106.3 mm.

Tail/total ratio. Males tended to have slightly longer tails than females. In both sexes, the relative length of the tail increased with increase in size, based on a comparison of tail and total lengths.

Colour and pattern. The dorsal ground colour varied considerably with size and, therefore, with age. Efts (immatures) were brick-red, small adults brownish, and larger adults greenish olive.

The mean total number of red spots for the sample was 6.8 : 6.7 for males and 6.9 for females. Spots were lacking in 13.2 per cent of the sample: 14.5 per cent of the males and 12.6 per cent of the females. Counts usually ranged from 0 to 17, but two specimens, a male with 46 spots and a female with 64, fell well beyond this limit (Figure 11). In the latter two specimens the spots were very small and scattered. All spots had a distinct black margin. Usually they were confined to the sides, but occasionally they were present on the head as well.

The amount of black dorsal speckling and spotting increased with size and therefore seems to correlate with age. The two efts lacked dorsal spotting. Large females were heavily spotted, with the spots often running together to give a slightly reticulated appearance. Specimens, intermediate in size, showed an increased amount of spotting with increased size, but the spotting in males never formed a reticulated appearance as in the females.

A light line was present along the mid-dorsal ridge in all specimens, but it increased in distinctness with increased spotting. It was most sharply defined in reticulated and heavily spotted large females.

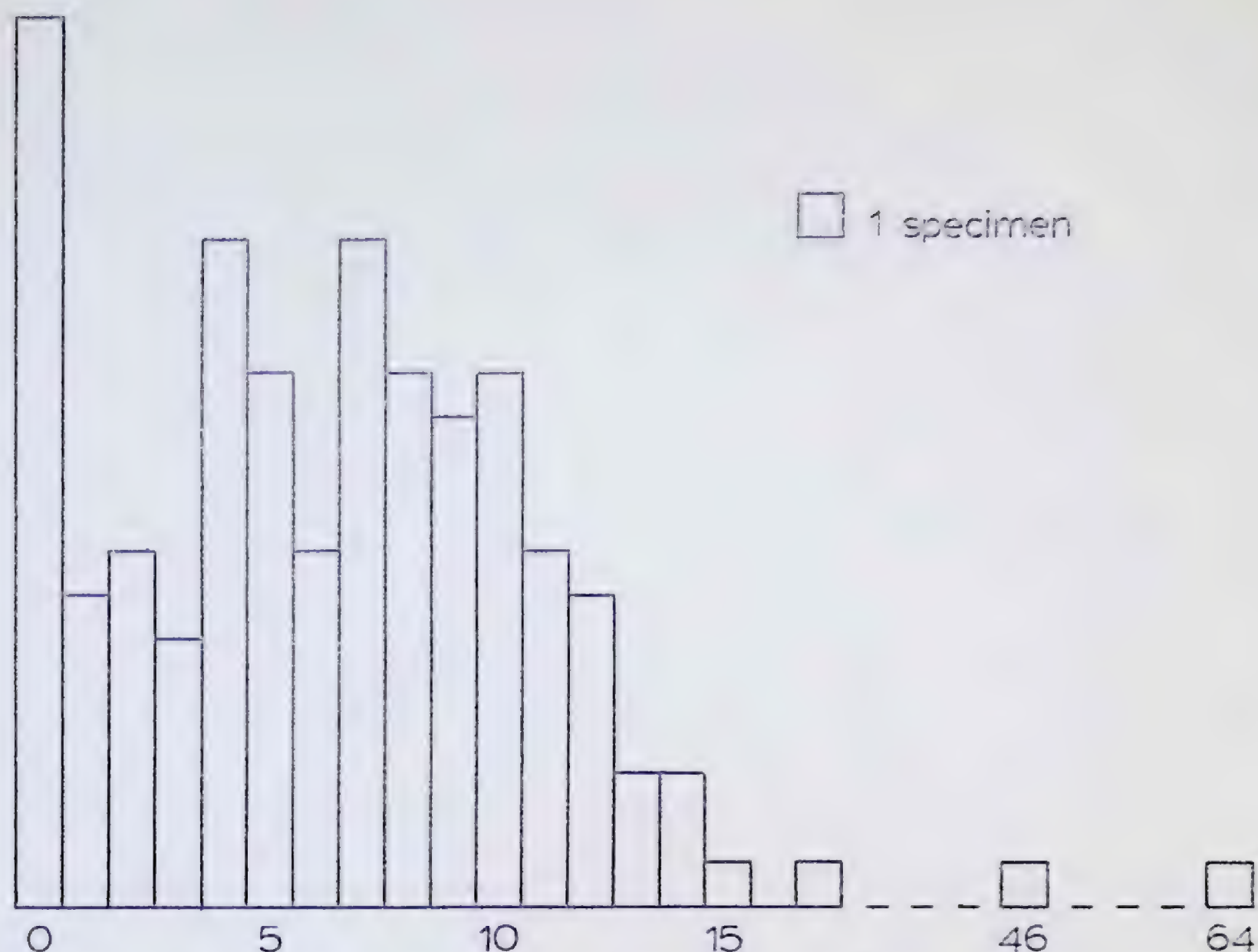


FIGURE 11—Histogram of number of red spots in *Notophthalmus v. viridescens*.

The venter was red in efts and bright yellow in aquatic adults. All specimens had black dots on the underside with little variation in size and number.

The tail fin was enlarged in aquatic adults. Females tended to have their tail spotting arranged lineally so that one or two longitudinal light lines were outlined along the lower half of the tail. In males the fin was deeper, and the black spots were larger and more scattered (Figure 9).

One partially-albino adult male, taken 0.6 miles southeast of Caledonia, Kings County, was pale yellow above instead of the normal olive-green. The yellow venter, the dorsal, lateral, and ventral black spotting, and the red spots were the same as those in typical specimens.

COMPARISON

Cox (1907) has described specimens from Afton Lake, Queens County, in detail, although apparently missing the significance of the sexual variation. He gives an excellent description of an adult female. He found the average total length to be 130 mm. Conant (1958) gave the record total length for this species as 5 inches (127 mm). The largest Prince Edward Island specimen in this study measured 137 mm, and twelve other specimens were more than 127 mm. Bishop (1941) found averages of specimens in New York State from 82.9 to 86.6 mm for females, and from 81.1 to 97.6 mm for males. Logier (1952) gave the range for Eastern Canadian specimens as usually

Bleakney (1952) reported for Nova Scotia a mean length of 92.5 mm for males, with extremes of 76 and 114 mm; and 86.3 mm for females, with extremes of 70 and 124 mm. Prince Edward Island adults, with a mean of 106.3 mm for males and 109.9 mm for females, were considerably larger, and the extremes of 80 and 137 mm were higher than the above authors gave for the species. The sexual difference of males being larger than females, noted by Bishop (1941) and evident in Bleakney's (1952) data, was reversed in the Island population where females were slightly larger.

FIELD NOTES

June 16 – July 10, 1958. Adults were abundant at only one locality, ponds 3.3 miles southwest of Bridgetown, where a few seine hauls netted 95 specimens on July 4. Other collections consist of only a few specimens from five scattered ponds in the southeast end of the province and one in the northwest. This is in marked contrast to statements by Bleakney (1954, 1958), who reported that the species was abundant throughout the Island.

Small larvae were collected on July 4, and an adult male and female were obtained in amplexus on the same date.

April 24 – 26, 1959. Newts at the Bridgetown locality were as abundant and as easily observed as during the previous summer. A female in amplexus with two males was collected. That pairs were collected in July also is an indication of prolonged breeding activity, from spring to midsummer.

May 9 – 10, 1959. Only one newt was seen, 0.6 miles east of Roseneath, Kings County.

SPECIMENS EXAMINED

PRINCE COUNTY. 2477. Portage, June 27, 1953 (2); 3767. Portage, July 8, 1958 (4). KINGS COUNTY. 2471. Bay Fortune, June 20, 1953 (1); 2472. Bay Fortune, June 20, 1953 (1); 2474. Upton, June 22, 1953 (1); 2475. Glenfanning, June 22, 1953 (13); 2476. Glenfanning, June 22, 1953 (2); 3653. 0.6 mi. se. of Caledonia, June 23, 1958 (1); 3702. 1.5 mi. w. of Cardigan, July 3, 1958 (1); 3706. 1.5 mi. w. of Cardigan, July 3, 1958 (1); 3726. 0.6 mi. e. of Roseneath, July 4, 1958 (3); 3733. 3.3 mi. sw. on Hwy. 5 of Bridgetown, July 4, 1958 (95); 3959. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (25).

LITERATURE RECORDS

Cox (1899b) was the first to record the species from Prince Edward Island, noting that the largest specimen he had seen was taken at Afton Lake (Queens County). This observation was repeated by Cox (1899c), and a detailed description of specimens was given in a later paper (Cox, 1907). It was listed from Prince Edward Island by Hurst (1944) and Logier (1952). Logier and Toner (1955, 1961) cited Cox's (1899c) record. Bleakney (1954) noted that it was "common in nearly every millpond throughout the island," based on his observations in 1953. Bleakney (1958) plotted Cox's record and his own 1953 collections.

Plethodon cinereus cinereus (Green)

Red-backed Salamander



FIGURE 12—Red-backed Salamander, *Plethodon c. cinereus*. NMC 3689-48. Male. Total length 86 mm. *Striped* phase (above). NMC 3694-5. Male. Total length 75 mm. *Lead* phase (below).

VARIATION

Eighty-six specimens were examined.

Body length. Specimens ranged from 7 to 52 mm, and three size classes, 7 to 17 mm (15 specimens), 23 to 25 mm (3), and 30 to 52 mm (68), may be represented, although paucity of individuals from the two lower groups made their separation only tentative. The individuals of 7 to 17 mm were



FIGURE 13—Histogram of body length in *Plethodon c. cinereus*.

considered to be hatchlings of the year. Specimens of 30 mm and more were considered sexually mature. Males varied from 31 to 52 mm, mean 44.2 mm; and females varied from 32 to 48 mm, mean 39.3 mm (Figure 13).

Total length. The longest specimen was 106 mm. Because of the high incidence of tail breakage and the varied amount of regeneration present, this measurement was of no value for comparison of individuals.

Costal grooves. Counts which were taken by the method outlined by Highton (1957) for *Plethodon*, should, therefore, represent one less than the number

of trunk vertebrae. Of 67 specimens exceeding 30 mm in body length, 79.1 per cent had 19 costal grooves, 16.4 per cent had 18, and 4.5 per cent had 20. The costal groove in the groin was usually forked, with the rear fork absent in most of the individuals with a count of 18.

Colour and pattern. Two phases occurred: *striped* (red-backed), with a wide red dorsal stripe and black sides; and *lead* (lead-backed), with uniform black sides and back. In the striped phase there was some variation in the amount of dark pigment present on the red stripe; however, the stripe was always distinct. The striped phase constituted 97.7 per cent of the total sample and the lead phase 2.3 per cent. The only examples with the lead coloration were taken near Hunter River, where two out of a collection of six were of this phase. In the only other collections, 54 from Granville and 26 from Dundas, all specimens were striped.

COMPARISON

Bleakney (1952) reported costal groove counts varying from 15 to 18, but usually 17, for Nova Scotia specimens, but this difference from Prince Edward Island counts is due to a different counting technique. Highton (1962) has examined specimens from throughout the range of the species, including the material reported on here, and his counts are in general agreement with those of the writer. Bleakney (1952) recorded a ratio of 6.05 red-backed (striped) to one lead-backed (lead) for 141 specimens from Nova Scotia, or 83.9 per cent striped and 16.2 per cent lead. Striped individuals comprised a higher percentage (97.7%) of the Prince Edward Island population samples.

FIELD NOTES

June 16 – July 10, 1958. This species was taken at only three localities, all millsites where the moist and rotting logs of old dams provided optimum habitat. Red-backed salamanders may have been reduced in numbers and distribution by the removal of most of the original forest. A salamander, verbally reported to have been seen under a board at Holland Cove, Queens County (PC: Dick Carson), may have been of this species.

The series of 54 specimens from Granville, July 1, contains all the young mentioned under 'Variation.'

April 24 – 27, May 9 – 10, 1959. No suitable habitats were examined during these periods.

SPECIMENS EXAMINED

QUEENS COUNTY. 3689. Granville, July 1, 1958 (54); 3694. 1.6 mi. ne. of Hunter River, July 2, 1958 (6); KINGS COUNTY. 3761. Boughton River millpond, 2.2 mi. n. of Dundas, July 7, 1958 (26).

LITERATURE RECORDS

This may have been the common species mentioned by Bain (1890) as being "found under stones and stumps." Cox (1899c) included Prince Edward Island in his range summary, and in a later paper Cox (1907) gave

"P.E. Island, Vanwart and Cox . . ." Apparently he found only the red-backed phase since he recorded it as *P. cinereus erythronotus*. It was included by Hurst (1944), who noted: "Frequents rotten logs, damp moss and sometimes get into cellars." Mills (1948) and Logier (1952) included Prince Edward Island in their range summaries, and Logier and Toner (1955) listed it on the authority of Cox (1907). These authors, in the revision of their checklist, (1961) added "Queens Co., Hunter River (PC: S. Bleakney); (NMC)" to Cox's record. The Bleakney communication was based on specimens examined in this report. Bleakney (1958) used only the reports of Cox and Hurst.

Bufo americanus americanus Holbrook

American Toad

VARIATION

A series of 168 adults was examined.

Body length. The mean length of 158 males was 67.8 mm, with extremes of 58 and 81 mm. Ten females had a mean length of 83.7 mm, with extremes of 63 and 93 mm (Figure 15).

Tibia/body ratio. The mean of the tibia length divided by the body length was 0.372 for adults. Males had a mean ratio of 0.372, with extremes of 0.343 and 0.408; females 0.367, with extremes 0.349 and 0.400.

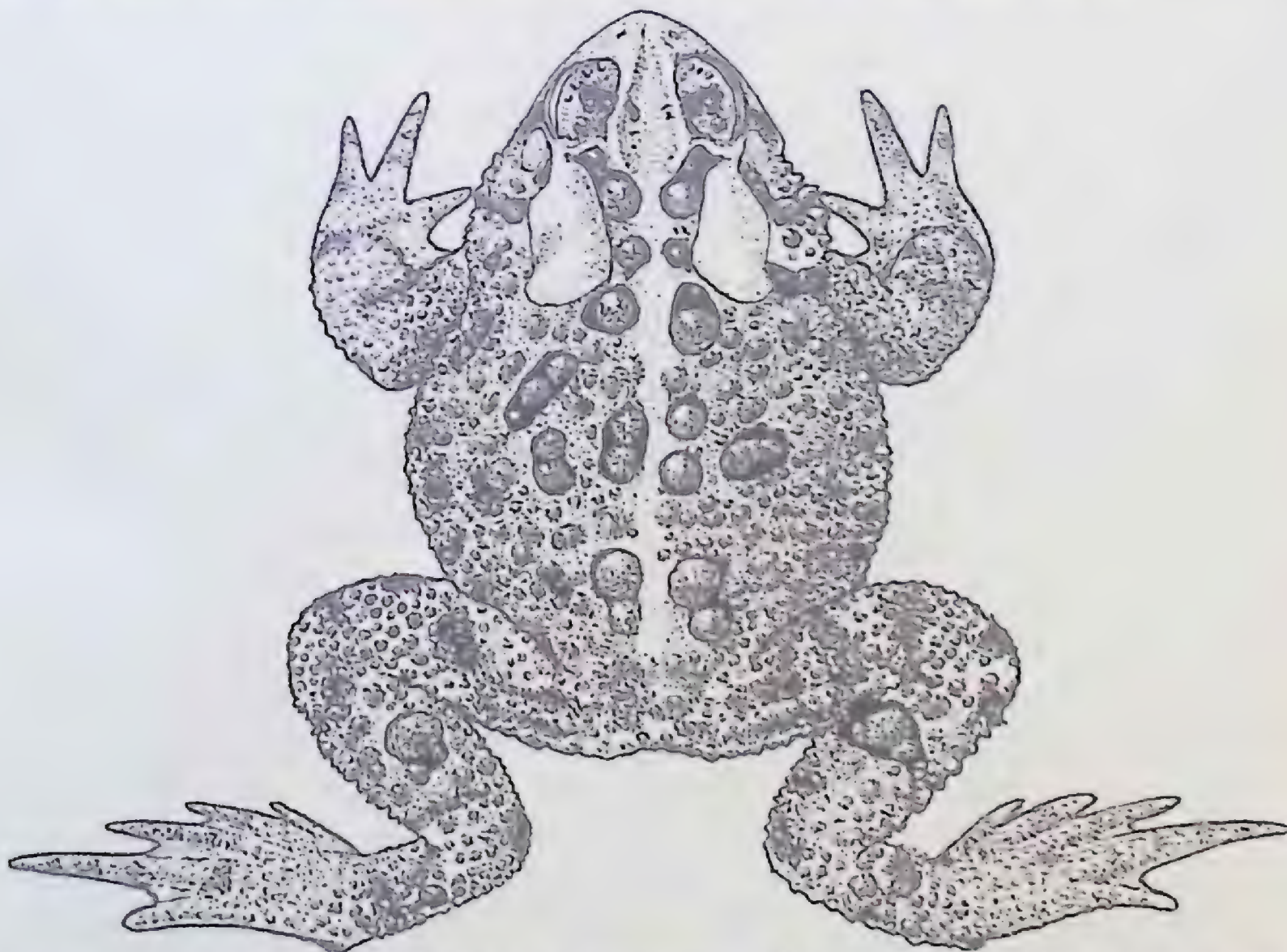


FIGURE 14—American Toad, *Bufo a. americanus*. NMC 3988-10. Male. Total length 67 mm.

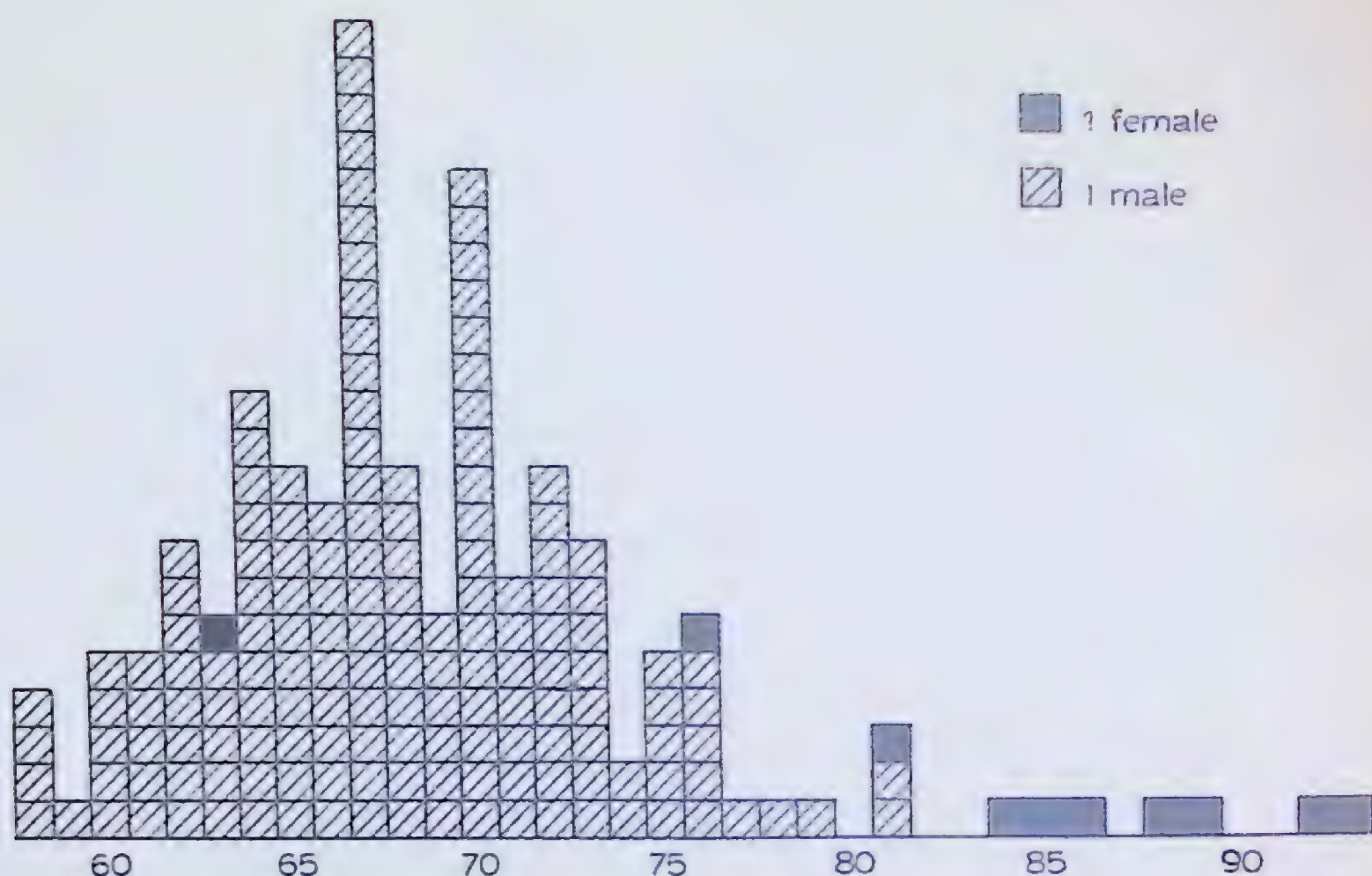


FIGURE 15—Histogram of body length in *Bufo a. americanus*.

Colour and pattern. The colour in life was variable, ranging from greenish to reddish brown. All specimens had a light line down the centre of the back from nose to vent. Patches of black, bordered by a narrow light margin, encompassed groups of warts and often formed crossbars on the legs. The sides were spotted or reticulated with black.

The ventrum varied from slightly spotted to heavily reticulated with black. The ventral marking classification outlined by Blair (1943), which was applied to the collection, yielded the following percentages for each class:

- (1) Venter unmarked (0)
- (2) Pectoral spot only (0)
- (3) Spots on anterior one-third of venter (6.0%)
- (4) Spots on more than one-third and not more than two-thirds of venter (11.9%)
- (5) Spots on more than two-thirds of venter (58.9%)
- (6) Venter reticulated (23.2%)

The mean class value was 4.99.

COMPARISON

Bleakney (1952) reported differences between toads collected from the Annapolis Valley in Nova Scotia and those collected from the rest of the province. Specimens outside the Valley were characterized by having black spots and/or black reticulations on the venter, while those in the Valley had the dark spots confined to the pectoral region. Although subsequent collecting has not justified the sharp division into two forms, and although the subspecific distinctness originally assigned has been discarded, the differences may be still weakly indicated (PC: J. S. Bleakney). The Prince Edward Island

sample is more similar to the extra-Annapolis Valley, N.S., toads in that 82.1 per cent of the sample has heavy spotting or reticulations.

FIELD NOTES

June 16 – July 10, 1958. Toads called during the entire period at Cavendish, where our field headquarters were located. In general, only a few individuals were heard at one time, and often they would be silent for several nights in a row. On June 21 a particularly loud chorus was investigated, and 26 male toads were collected. Throughout this period toads were also heard in many other localities, and choruses of thirteen (Granville, June 26) and eight (Rocky Point, June 28) were collected. Most of the additional calling heard was from only one or two individuals. Two egg strings were found 1.2 miles west on Hwy. 3 of Millview, Queens County, on June 23. One was in an advanced stage of development, but the other appeared to have been laid not long before collecting. On June 28 at Rocky Point, tadpoles were observed in all stages of development, from recently hatched individuals to those with well-developed hind legs and front ones about to appear. Newly transformed toads were collected on July 4, 7, and 9.

April 24 – 26, 1959. During the first two nights, toads were neither seen nor heard. These were typically cool spring nights with *Rana sylvatica* very vocal but with no sound yet from *Hyla crucifer*. April 26 was a hot, sunny day, followed by heavy rain, which began about dark. In the evening toads began to gather at the ponds, and strong choruses were heard. At 0.6 miles east of Roseneath, Kings County, two pairs in amplexus were taken.

May 9 – 10, 1959. On the evening of May 9 a pair of toads laying eggs was collected, but generally there was little vocal evidence of the species at Roseneath. One additional string of recently laid eggs was seen. On May 10 toads were calling in the afternoon at the ponds below the YMCA Camp at Rocky Point. A vigorous chorus was present at Roseneath in the evening, but no females were seen.

Toads are abundant on the Island and apparently may breed from early spring until midsummer. Undoubtedly the breeding observed in April was due to an abnormally hot day for that time of year, with the temperature stimulus reinforced by heavy rain.

SPECIMENS EXAMINED

PRINCE COUNTY. 3669. North Tryon, June 28, 1958 (1); 3774 $\frac{3}{8}$ mi. s. of Bloomfield Corner, July 8, 1958 (1); 3781. Springfield West, July 9, 1958 (1). QUEENS COUNTY. 2496. Stanley Bridge, June 25, 1953 (1); 3632. Cavendish, June 21, 1958 (26); 3633. 1.6 mi. e. on Hwy. 2 of Hazelbrook, June 23, 1958 (1); 3646. 1.2 mi. w. on Hwy. 3 of Millview, June 23, 1958 (2); 3663. 1 mi. w. of Hunter River, June 26, 1958 (1); 3665. Granville, June 26, 1958 (14); 3674. 1.4 mi. w. on Hwy. 19 of Fairview (School), June 28, 1958 (1); 3681. 0.8 mi. e. on Hwy. 19 of Fairview (School), June 28, 1958 (1); 3684. Rocky Point, June 28, 1958 (9); 3695. Cavendish, July 2, 1958 (1); 3700. 1.2 mi. w. on Hwy. 3 of Millview, July 3, 1958 (2); 3982. YMCA Camp, 1.2 mi. s. of Rocky Point,

May 10, 1959 (5). KINGS COUNTY. 2494. Georgetown, June 17, 1953 (29); 2495. Georgetown, June 18, 1953 (1); 3738. 3.3 mi. sw. on Hwy. 5 of Bridgetown, July 4, 1958 (5); 3758. Boughton River millpond, 2.2 mi. n. of Dundas, July 7, 1958 (6); 3958. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (4); 3964. 0.6 mi. e. of Roseneath, April 26, 1959 (31); 3970. 0.6 mi. e. of Roseneath, May 9, 1959 (2); 3988. 0.6 mi. e. of Roseneath, May 10, 1959 (20); 3997. Roseneath, May 10, 1959 (10).

LITERATURE RECORDS

Bain (1890) mentioned its occurrence. Cox (1899a, 1899b, 1899c) stated that this species occurs in all the Maritime Provinces. Fowler (1915) identified specimens "from Black Pond, Charlottetown, and East Lake near Bothwell." Hurst (1944), who remarked that it was well known, and Logier (1952) recorded it from Prince Edward Island. Logier and Toner (1955, 1961) cited a Royal Ontario Museum specimen from Souris, Kings County. Bleakney (1954) noted that it was found during the 1953 expedition and (1958) plotted the ROM* record and two National Museum collections, one each from Prince and Kings counties.

Hyla crucifer crucifer Wied

Spring Peeper



FIGURE 16—Spring Peeper, *Hyla c. crucifer*. NMC 3965-4. Male. Body length 32 mm.

*Royal Ontario Museum.

VARIATION

Ninety-four adults were examined.

Body length. The 88 males varied from 27 to 35 mm, with a mean of 31.4 mm; the 6 females varied from 34 to 36 mm, with a mean of 35 mm (Figure 17).

Tibia/body ratio. This ratio had a mean value of 0.428 for males, with extremes of 0.394 and 0.467. For females the figure was 0.431, with extremes of 0.417 and 0.443.

Colour and pattern. All individuals were some shade of brown in life, with an irregularly shaped dorsal marking that only rarely took the form of

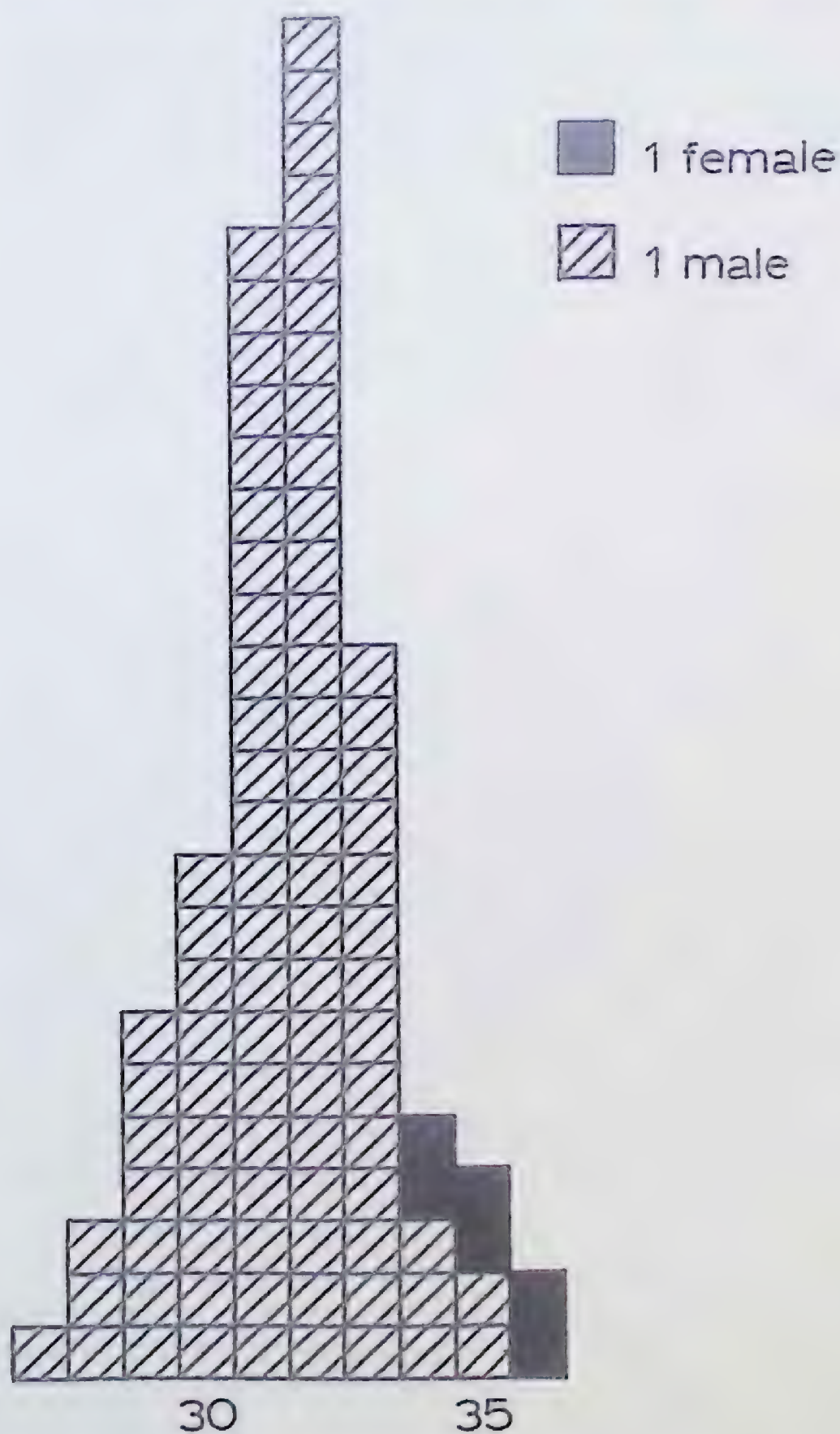


FIGURE 17—Histogram of body length in *Hyla c. crucifer*.

the 'X'-shaped marking for which the species was named. A dark line was present across the head, joining the eyelids. Often this was more or less shallowly 'V'-shaped, with its apex toward the neck. A line was usually visible from the snout back to this 'V.' There was a more or less distinct line on each side, from the nostril through the eye, above the front leg, and back along the body. The hind legs were usually barred but occasionally spotted. The underside was yellowish white and granular in appearance. The throat was very darkly pigmented in males but was the same colour as the venter in females. The hind leg was usually pale yellow underneath with a brighter yellow evident on the sides of the femur.

COMPARISON

Wright and Wright (1949) gave the size variation as from 18 to 29 mm, and Conant (1958) stated the range as $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches (19.1 to 31.8 mm), with a record of $1\frac{3}{8}$ inches (34.9 mm). Logier (1952) remarked that the species rarely exceeds 30 mm in Eastern Canada. Bleakney (1952) found the mean length of 27 males from Nova Scotia to be 27.8 mm, with extremes of 25.4 and 31.8 mm. Measurements of Prince Edward Island specimens gave a mean of 31.4 mm for males, with extremes of 27 and 35 mm. Two of the females each measured 36 mm. Thus, in mean length and maximum size, the Island sample is larger, but comparative material from adjoining areas is too scanty at present to permit large size to be considered distinctive for the Island alone.

FIELD NOTES

June 16 – July 10, 1958. At the Cavendish field base this *Hyla* was heard calling from June 16 to 25, but only sporadically. Not more than one or two individuals were heard on any one night. Tadpoles were abundant in most suitable temporary ponds, such as quarry ponds and roadside ditches.

April 24 – 26, 1959. Although *Rana sylvatica* was breeding when we arrived on April 24, no *Hyla crucifer* were heard until two nights later, when a hot day followed by heavy rain produced ideal spring breeding conditions for amphibians. Although many were heard on this evening, they did not seem to represent a vigorous breeding chorus. This is in contrast to *Bufo americanus* which, perhaps because it could cover the distance from hibernating site to pond faster than the smaller *Hyla crucifer*, responded immediately to these conditions and formed a vigorous breeding chorus the same evening.

May 9 – 10, 1959. Several large choruses were heard during both nights. As the evenings were fairly cool, individuals were calling from among clumps of grass.

This species is abundant on the Island, and its breeding period seems to have the same relation to that of *Rana sylvatica* as is the case in other parts of Eastern Canada; that is, it starts calling a few days after *R. sylvatica* has started, and choruses reach a full intensity at the time *R. sylvatica* choruses are declining. As in other parts of its range, occasional males call at or near ponds on into early summer.

SPECIMENS EXAMINED

PRINCE COUNTY. 3974. 1.5 to 1.8 mi. s. of Grand River, May 9, 1959 (26). QUEENS COUNTY. 3615. Stanley Bridge, June 17, 1958 (1); 3984. YMCA Camp, 1.2 mi. s. of Rocky Point, May 10, 1959 (5). KINGS COUNTY. 2493. Georgetown, June 17, 1953 (5); 3965. 0.6 mi. e. of Roseneath, April 26, 1959 (4); 3986. 0.6 mi. e. of Roseneath, May 10, 1959 (46); 3990. Roseneath, May 10, 1959 (11).

LITERATURE RECORDS

This is undoubtedly the Tree Toad referred to by Bain (1890). Cox (1899a, 1899c) listed this species from all Maritime Provinces. Hurst (1944) and Logier (1952) placed it definitely on the Prince Edward Island list. Logier and Toner (1955, 1961) gave two localities: Souris, Kings County, and Lot 16, Prince County, based on Royal Ontario Museum specimens. Bleakney (1954) noted that it was found during the 1953 survey and (1958) plotted Logier and Toner's records as well as a National Museum collection from Kings County.

Rana clamitans melanota (Rafinesque)

Green Frog

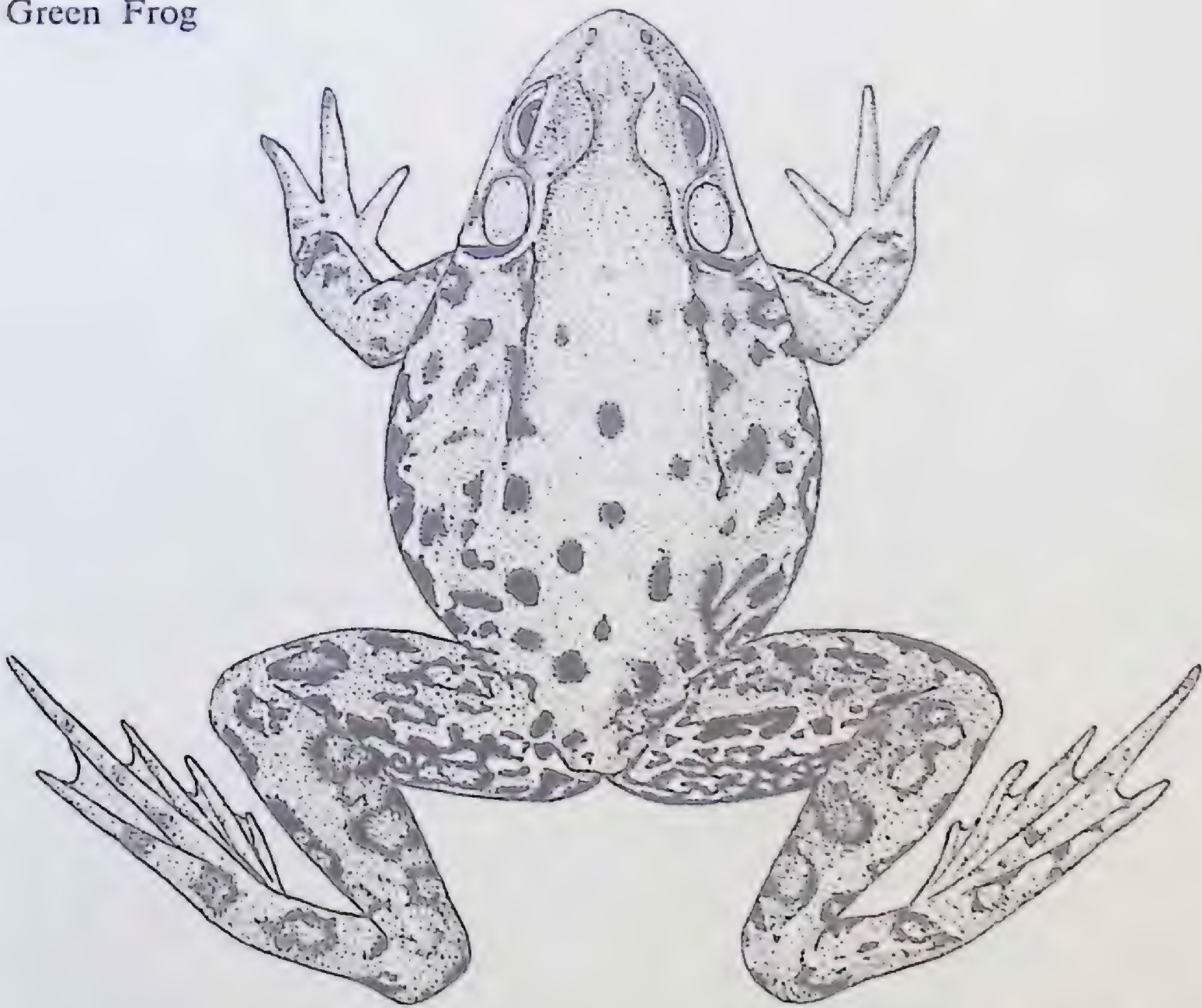


FIGURE 18—Green Frog, *Rana clamitans melanota*. NMC 3755-1. Female. Body length 85 mm.

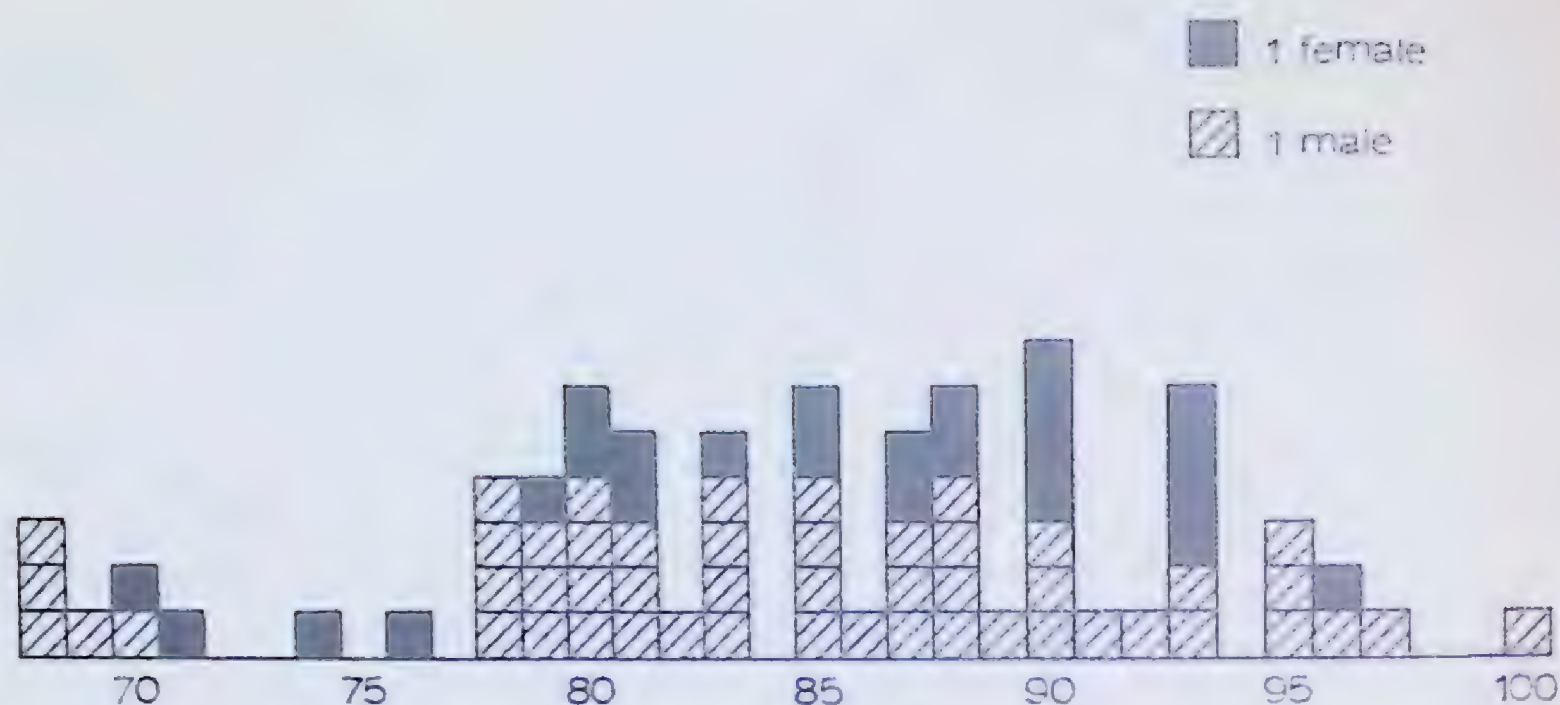


FIGURE 19—Histogram of body length in *Rana clamitans melanota*.

VARIATION

Of the material examined, 75 specimens were considered sexually mature on the basis of secondary sexual characteristics.

Body length. Fifty males had a mean length of 84.1 mm, with extremes of 68 and 100 mm. Twenty-five females varied from 70 to 96 mm, with a mean length of 84.8 mm (Figure 19).

Tibia/body ratio. The mean ratio for the total sample was 0.456. Males had a mean of 0.458, with extremes of 0.430 and 0.488. Females had a mean of 0.452, with extremes of 0.422 and 0.500.

Colour and pattern. Whereas they are various shades of green and brown in life, in preservation all specimens had faded to a dull brown but the markings were still distinct. The individual variation ranged from absence of markings on the back to heavy mottling. Spots, when present, were variable in size and irregular in distribution. Bars were present on the hind legs in many specimens, but in others these were replaced by mottling or spotting. The belly was unmarked, but some specimens exhibited a dusky mottling around the outer edge of the throat. In sexually mature males the throat was bright yellow in life.

COMPARISON

Logier (1952) gave the lengths of the largest male and female from Eastern Canada in the Royal Ontario Museum collection as 94 and 98 mm respectively. In the Prince Edward Island sample the largest male was 100 mm and the largest female 96 mm. Conant (1958) reported the record length for the species as 4 inches (101.6 mm) and the usual length as up to 3½ inches (88.9 mm). Fifteen out of the 75 Prince Edward Island specimens, or 20 per cent, were more than 90 mm long, although none exceeded Conant's maximum.

FIELD NOTES

June 16 – July 10, 1958. Sporadic choruses or single individuals were heard throughout this period, and adults were collected. Egg masses were found on July 3, 1.5 miles west of Cardigan, and on July 4 at Roseneath. The egg masses were the typical surface mass described for the species. They were both laid in the cattail edges of the pond, the mass tending to be spread out and entangled with the cattail stems. Transforming individuals were collected from July 3 to 7 from a variety of localities. Juveniles were often collected.

April 24 – 26, 1959. One juvenile, taken April 26, was the only individual seen. Large tadpoles, presumably this species, were occasionally seen in the larger ponds.

May 9 – 10, 1959. Additional observations of large tadpoles were made, but no adults or juveniles were seen. The weather was slightly cooler on both days than it had been on April 26.

Green Frogs are common to abundant throughout the Island. They avoid the most temporary shallow ponds, such as flooded ditches, but were found in the deeper quarry ponds, millponds, and other usually permanent bodies of water. Young individuals may be found along the edges of temporary bodies of water, such as small ponds and streams, usually near a permanent water area.

It is certain that tadpoles of this species usually overwinter on Prince Edward Island. It is not known if breeding is ever early enough to allow any of the tadpoles to transform by their first autumn.

SPECIMENS EXAMINED

PRINCE COUNTY. 2505. Kensington, June 27, 1953 (1); 2709. Ellerslie Pond, June 17, 1953 (1); 3762. 1 $\frac{3}{8}$ mi. se. of St. Nicholas Station, July 8, 1958 (1); 3766. Portage, July 8, 1958 (1); 3773. 1 mi. s. of Tignish, July 8, 1958 (1); 3785. 1 $\frac{3}{8}$ mi. e. of Glenwood, July 9, 1958 (2); 3791. 3 $\frac{1}{8}$ mi. sw. of O'Leary, July 9, 1958 (2). QUEENS COUNTY. 3612. Cavendish, June 17, 1958 (1); 3617. Cavendish, June 17, 1958 (2); 3626. 1.9 mi. w. of Brookfield, June 19, 1958 (1); 3631. Cavendish, June 21, 1958 (5); 3634. 1.6 mi. e. on Hwy. 2 of Hazelbrook, June 23, 1958 (1); 3640. 1.8 mi. w. on Hwy. 3 of Millview, June 23, 1958 (3); 3650. 1.6 mi. n. of Grand View, June 23, 1958 (1); 3659. 1.6 mi. ne. of Hunter River, June 25, 1958 (2); 3688. Cavendish, June 29, 1958 (3); 3691. Granville, July 1, 1958 (3); 3744. 1.7 mi. ne. of Oyster Bed Bridge P. O., July 6, 1958 (1). KINGS COUNTY. 2502. Georgetown, June 17, 1953 (1); 2503. Georgetown, June 18, 1953 (2); 2504 Bay Fortune, June 20, 1953 (11); 3703. 1.5 mi. w. of Cardigan, July 3, 1958 (3); 3705. 1.5 mi. w. of Cardigan, July 3, 1958 (15); 3716. Roseneath, July 4, 1958 (20); 3724. 0.6 mi. e. of Roseneath, July 4, 1958 (9); 3755. 1 mi. n. of Dundas, July 7, 1958 (4); 3957. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (1); 3759. Boughton River millpond, 2.2 mi. n. of Dundas, July 7, 1958 (9).

LITERATURE RECORDS

Cox (1899a, 1899c) included Prince Edward Island in the range of this species (as *Rana fontinalis*) but unfortunately caused a great deal of confusion for subsequent workers by stating in a third paper (Cox, 1899b) that in the Maritime region it was "rather uncommon. Its place is taken by *Rana septentrionalis* in Gaspé, New Brunswick and Prince Edward Island." That there was an error either in the manuscript or in typesetting is evident, as the statement is contradicted by the other two papers of the same year.

Hurst (1944) recorded the species from Prince Edward Island as *Rana clamitans*, as did Logier (1952). Logier and Toner (1955) gave no localities, but in their revision (1961) they cited "Kings Co., Souris (ROM)." Bleakney (1954) noted that it was found on the 1953 expedition and (1958) plotted National Museum of Canada collections from Prince and Kings counties.

As discussed under 'Rejected Records,' the specimens "from large swamp in Dundee" on which Fowler's (1915) report of *Rana septentrionalis* is based were examined and found to be *Rana clamitans*. It is likely that his two other references to *Rana septentrionalis* "from Black Point, between Southport and Lake Verde, Tignish" also refer to *Rana clamitans*, although the specimens cannot be located.

Rana sylvatica Le Conte

Wood Frog

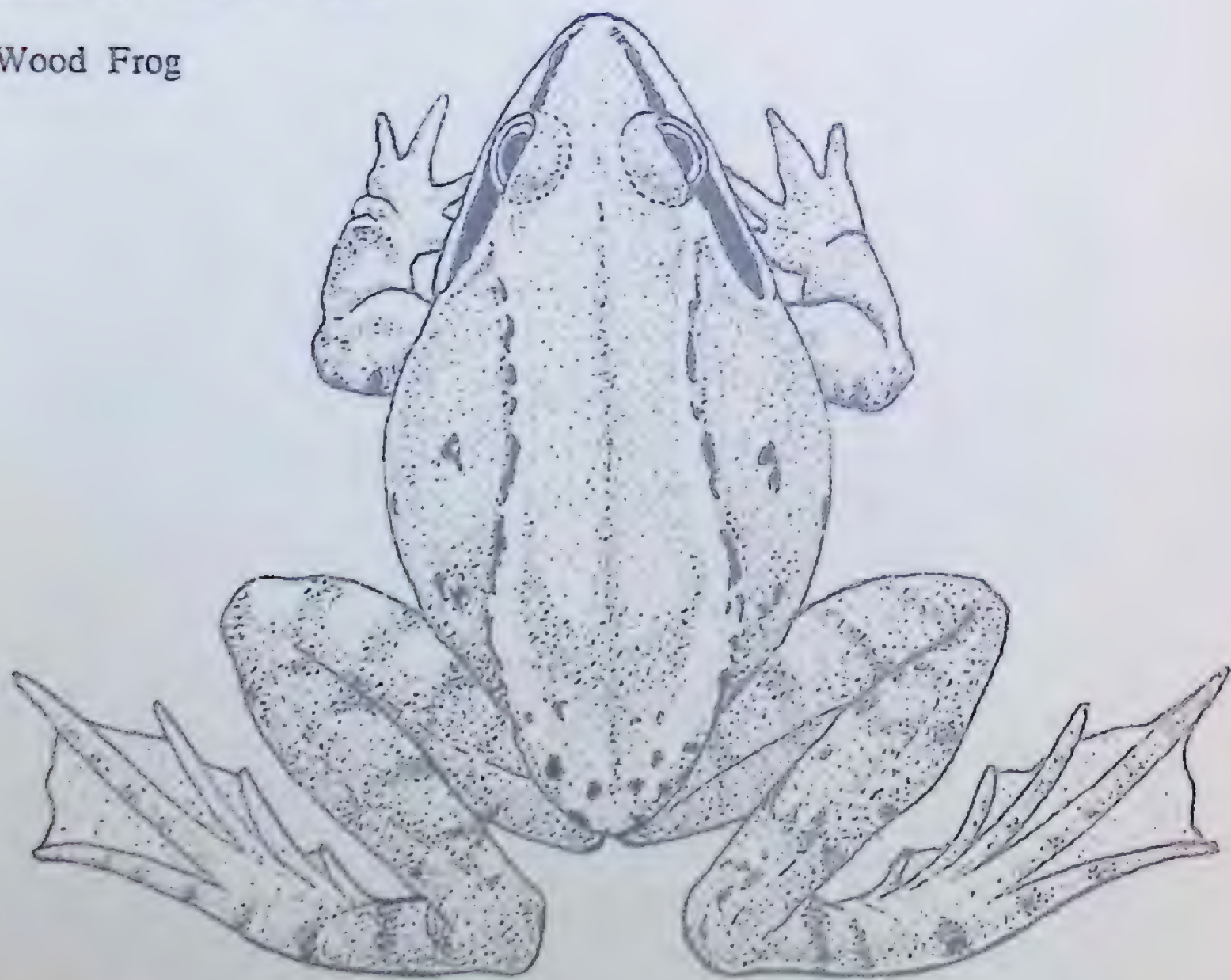


FIGURE 20—Wood Frog, *Rana sylvatica*. NMC 3955-48. Male. Body length 53 mm.

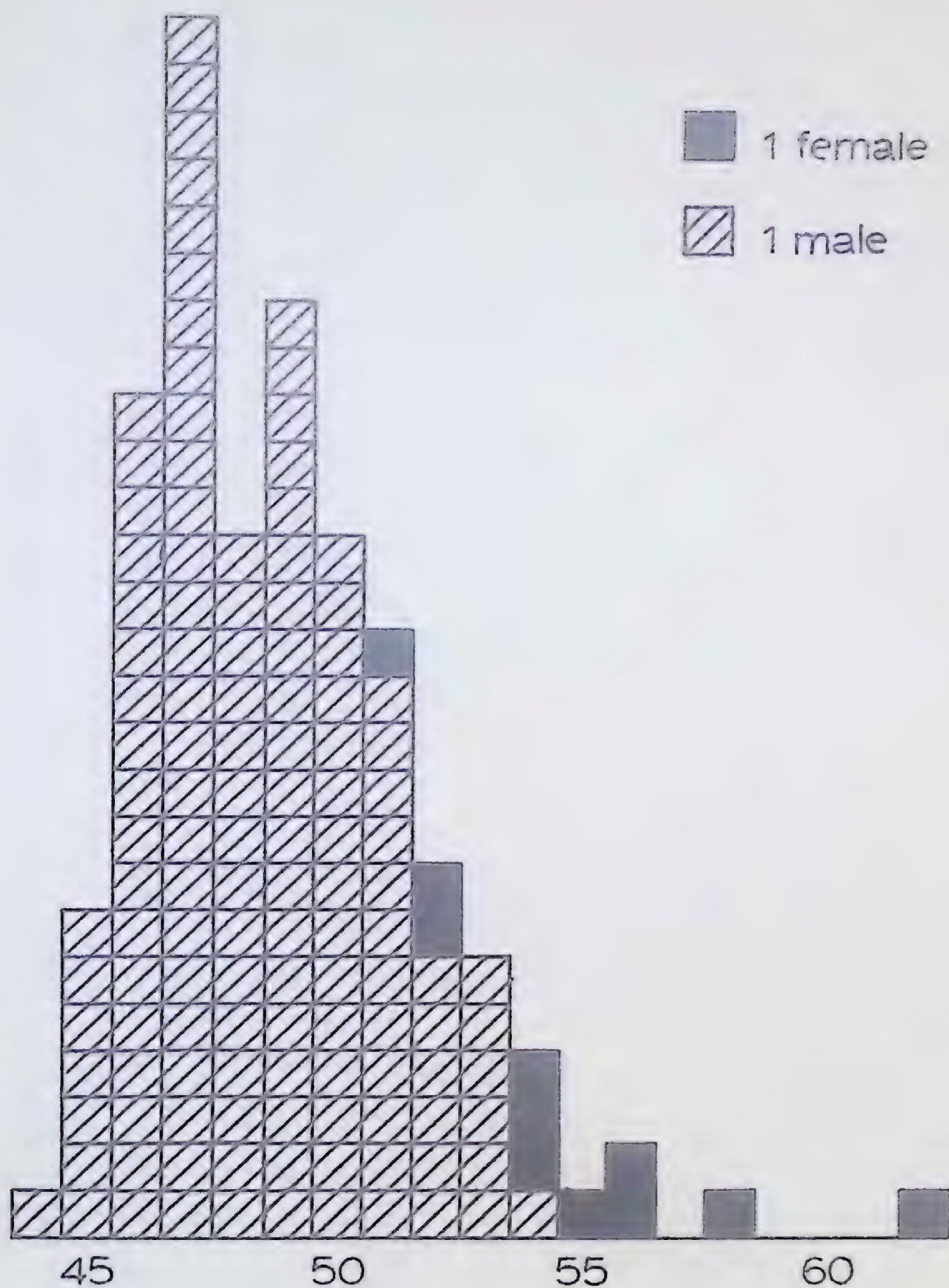


FIGURE 21—Histogram of body length in *Rana sylvatica*.

VARIATION

A series of 138 adults, all collected during spring breeding, was examined.

Body length. The mean size for 127 males was 48.5 mm and for 11 females 54.9 mm (Figure 21). The mean body length for females divided by that for males gave a ratio of 1.12.

Tibia/body ratio. The length of the tibia divided by the body length gave a ratio of 0.517 for the total sample. Separately, the ratios were 0.516 for males and 0.527 for females.

Colour and pattern. Most of the specimens were some shade of dark brown in life, but some individuals were distinctly greyish or reddish. One large female, measuring 62 mm, was distinctly red. As a rule, females tended to be reddish, but one exception exhibited the typical brown observed in males. Males tended to be much darker brown when collected at the breeding pond, and the colour became lighter after a few hours in captivity.

Tibial bars were often partially or completely indistinct. Counts were made of the clearly distinct bars on the right legs of all specimens. They were indistinct in 9.5 per cent, and 4.4 per cent had one bar, 78.1 per cent had two, and 0.7 per cent had four. The mean tibial bar number for the sample was 1.78.

Small warts, often edged with black, were usually present on the back and sides. On the hind legs they were almost always present but occasionally indistinct. Black spotting varied from markedly present to absent on the lower part of the sides. Specimens exhibiting this spotting almost invariably had all their dorsal and lateral warts edged with black. The black 'mask' from snout to tympanum was prominent in all individuals. None had a mid-dorsal white line. The chin and belly tended to be more or less spotted, with markings absent to very intense.

COMPARISON

Martof and Humphries (1959) have presented a thorough analysis of this species based on a study of 2,801 specimens from all parts of its range. Unfortunately, adequate material from Quebec and the Maritimes was not available to them at the time, and they had to rely on 14 specimens from Quebec, 4 from New Brunswick, 12 from Nova Scotia, and 2 from Prince Edward Island.

For the above paper, the mean body length, relative leg length, body length of males divided by that of females, and two aspects of pattern — dorsal stripe and tibial bars — were analysed. The results were presented on range maps which depicted the extent of various arbitrary classes for each character.

The results obtained here are not completely comparable with their data, since fresh rather than preserved specimens were measured.

In regard to male/female body length ratio, Martof and Humphries included Prince Edward Island in a region with a ratio of less than 1.10, whereas the ratio obtained from the sample examined here was 1.12. In number of tibial bars, the figure for the series examined is close to the figures given for specimens from northern Quebec and Labrador, although its mean of 1.78 is lower than the average of 2.0 to 2.5 given for that area. It does not agree with the 3.0 to 3.5 value assigned to Prince Edward Island. In body length, relative leg length, and absence of dorsal stripe, the samples agree with averages of the regions in which *Rana sylvatica* was included for each of these characters. Interestingly, in all the above categories except dorsal stripe, the average for the Prince Edward Island population agrees with the average for Quebec specimens.

In addition to the above characters, Martof and Humphries divided their material into various 'phenotypes' based on general appearance only. The Prince Edward Island sample seems to best fit their description of the *Appalachian* type. There is general agreement with most of its characters in the majority of specimens, i.e., lack of a dorsal stripe, frequent redness of body, dorsolateral spots of black to dark brown, extension of dorsal pigment over the sides of the body, and rugose hind legs. In addition, many specimens have the abrupt transition from dorsal to ventral colour described for Maine populations. Often the ventral markings are strongly contrasted with the light background colour. The dusky mid-dorsal area of the *Midwest* type is lacking, as are most other characters which separate this type from the *Appalachian* type.

FIELD NOTES

June 16 – July 10, 1958. Tadpoles of this species were common in temporary ponds such as quarry ponds and roadside ditches. The first transformed individuals were taken July 4, 3.3 miles southwest on Hwy. 5 of Bridgetown. No adults were seen during this period.

April 24 – 26, 1959. Wood Frogs were calling on April 24, and four fresh egg masses were seen in a ditch pond 1.5 to 1.8 miles south of Grand River, Prince County. They were calling throughout the areas where the author collected during this period, with an exceptionally large chorus during the perfect spring conditions of April 26 (a warm, rainy night), at a point 3.3 miles southwest on Hwy. 5 of Bridgetown, Kings County. Amplexing pairs and fresh egg masses were abundant.

May 9 – 10, 1959. Wood Frogs were still calling during this period, but in lesser numbers. Individuals seemed more wary than they had been in April. Many egg masses in various stages of development were observed.

This species is abundant on Prince Edward Island. The limited data gathered on the two spring trips indicate the same breeding pattern followed elsewhere in their range. The first frogs to call in the spring, they rapidly build a peak chorus on the first few warm nights, after which calling tapers off rapidly.

The writer's observations over a six-year period at Wolfville, in the Annapolis Valley of Nova Scotia, indicate that *Rana sylvatica* is at the peak of its breeding period about the middle of April, or shortly after, and may call as early as April 4. On Prince Edward Island, peak calling was observed on April 26, an exceptionally warm night. This indicates a breeding season difference of a week or ten days between the two areas. The Annapolis Valley populations probably benefit from a slightly earlier spring than do those of most of mainland Nova Scotia.

SPECIMENS EXAMINED

PRINCE COUNTY. 3940. 1.5 to 1.8 mi. s. of Grand River, April 24, 1959 (12); 3948. Portage, April 25, 1959 (1); 3975. 1.5 to 1.8 mi. s. of Grand River, May 9, 1959 (11); 2527. Cavendish, June 25, 1953 (1); 3967. 1.8 mi. w. on Hwy. 3 of Millview, April 26, 1959 (4); 3977. Victoria Park,

Charlottetown, May 10, 1959 (1). KINGS COUNTY. 2526. Georgetown, June 18, 1953 (1); 3955. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (82); 3962. 0.6 mi. e. of Roseneath, April 26, 1959 (20); 3987. 0.6 mi. e. of Roseneath, May 10, 1959 (4).

LITERATURE RECORDS

Bain (1890) commented on its breeding in Prince Edward Island. Cox (1899a, 1899b, 1899c) and Logier (1952) mentioned it for the Maritimes as a whole, and Hurst (1944) included it in his Prince Edward Island list. Fowler (1915) gave one locality "near Charlottetown." Logier and Toner (1955) cited "*Queens Co.*, Charlottetown (Fowler 1915, p. 518)." Bleakney (1954) noted that it was found by the 1953 expedition and (1958) plotted Fowler's record in Queens County and National Museum localities in Prince and Kings counties. Martof and Humphries (1959) examined two specimens from Charlottetown (1) and "Sauris" (Souris) (1). Logier and Toner (1961) cited "*Kings Co.*, Souris (ROM). *Queens Co.*, Charlottetown (Fowler 1915, p. 518)."

Rana pipiens Schreber

Leopard Frog



FIGURE 22—Leopard Frog, *Rana pipiens*. NMC 3619-1. Female. Body length 91 mm.

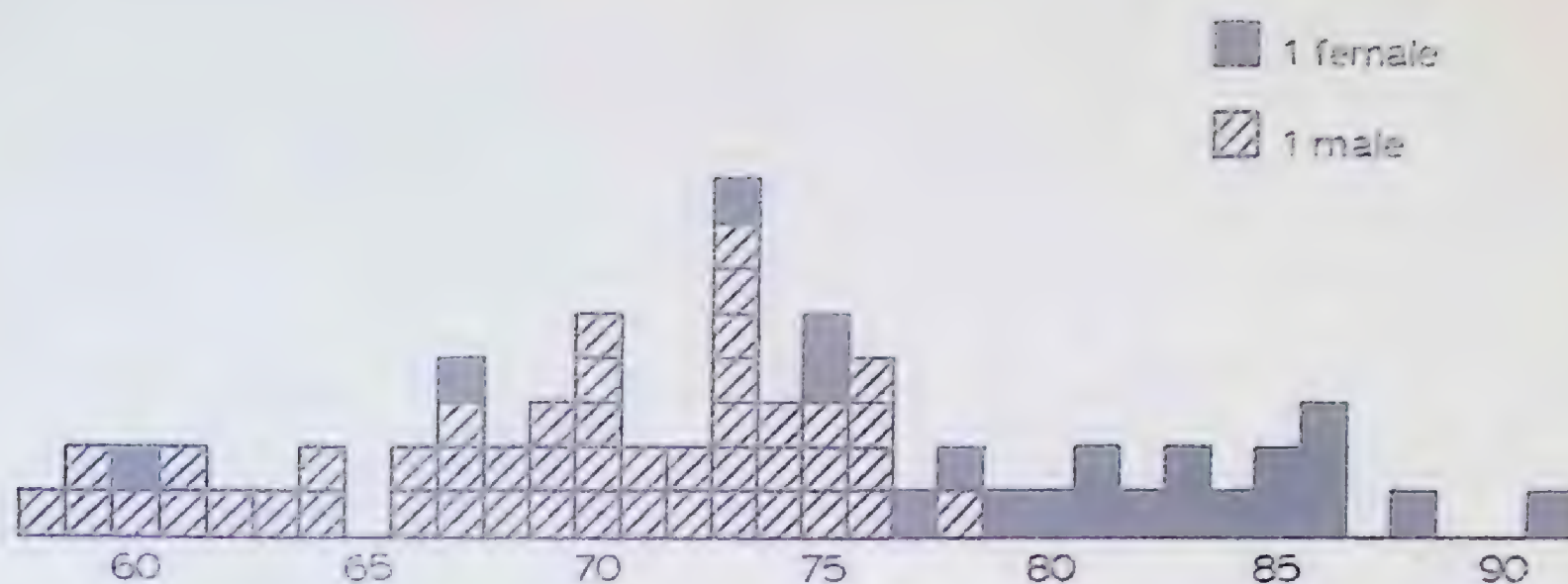


FIGURE 23—Histogram of body length in *Rana pipiens*.

VARIATION

One hundred and thirty-one specimens were examined. Sixty-nine of these were considered sexually mature on the basis of secondary sexual characteristics.

Body length. The mean body length for 47 males was 69.4 mm, with extremes of 58 and 78 mm. Twenty-two females had a mean of 80.2 mm, with extremes of 60 and 91 mm (Figure 23).

Tibia/body ratio. The mean of the tibia length divided by the body length for adults was 0.509. For males it was 0.512, with extremes of 0.473 and 0.566; for females 0.501, with extremes of 0.480 and 0.524.

Colour and pattern. The ground colour in live specimens was green or brown. The spots were variable in number and arrangement. They were always present on the back, sides, and legs, with those of the hind legs tending to form partial bars across the legs. Spots were counted on the back from the nose to the vent between the dorsolateral folds. The number for adults and immatures varied from 6 to 20, with a mean of 12.87 (Figure 24). The spots were arranged more or less in two parallel rows with a few spots often scattered in between, occasionally forming part of a third parallel row. Spots were usually well separated and round, although sometimes they were contiguous, elongated, or run together.

COMPARISON

Bleakney (1952) gave an average spot number of 14.36, with extremes of 8 to 27 for Nova Scotia specimens. Moore (1944) stated an average of 11.6 for nineteen Quebec specimens. The Prince Edward Island mean of 12.87, with extremes of 6 and 20, is not of significant difference in such a variable species.

FIELD NOTES

June 16 – July 10, 1958. A few were heard calling on June 28, 1.5 miles east of Borden, Prince County, but no other vocal activity was noted during this period. No transforming individuals were collected, but many young frogs that had probably recently transformed were taken throughout the collecting period. Adult frogs were often collected.

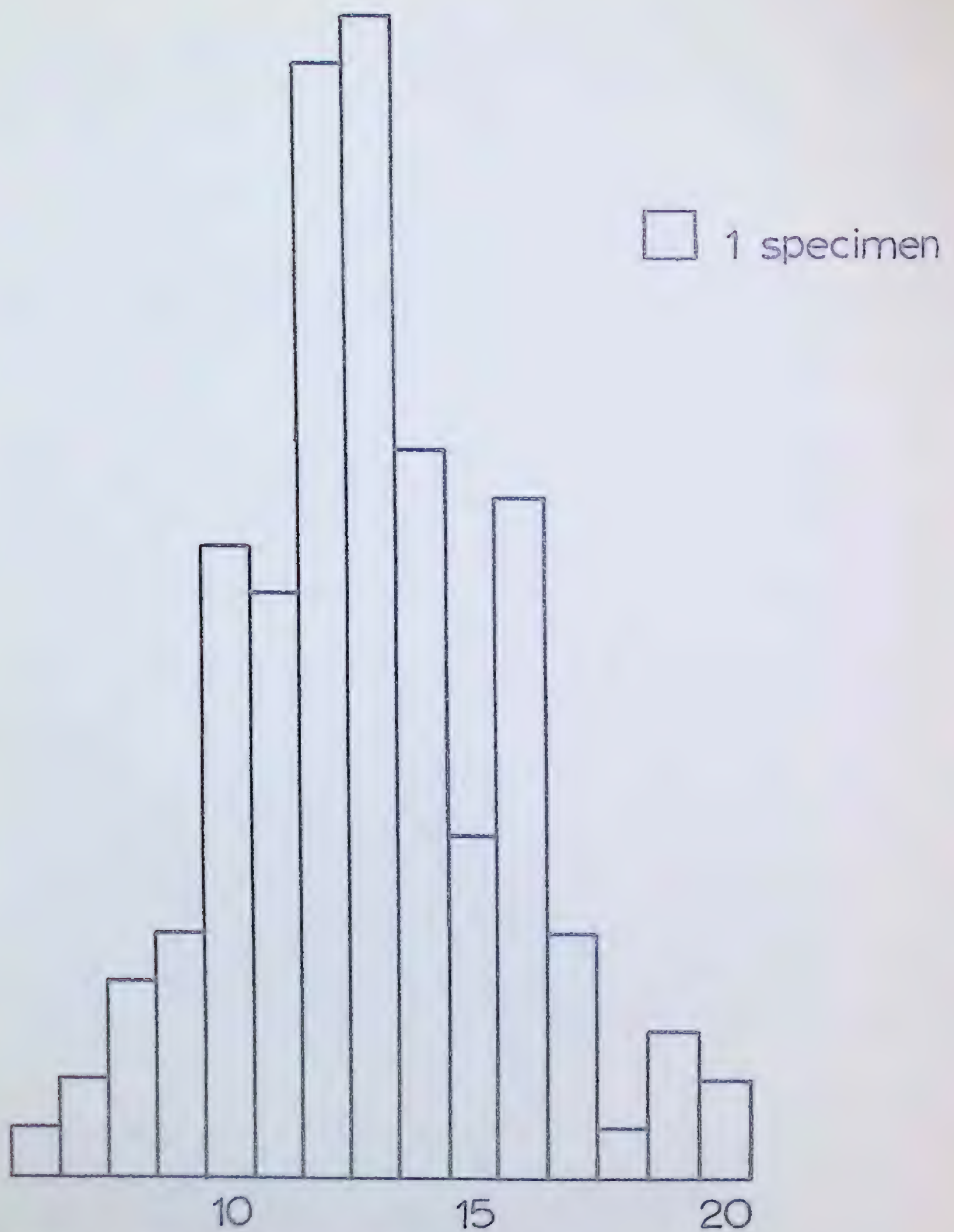


FIGURE 24—Histogram of dorsal spot number in *Rana pipiens*.

April 24 – 26, 1959. No individuals were seen or heard on April 24, but the next day one or two were calling occasionally at Portage, Prince County, and a couple were calling at one locality, 1.8 miles west on Hwy. 3 of Millview, Queens County, that evening. Several were calling vigorously on April 26 at two localities, but no chorus developed despite the ideal amphibian conditions. No egg masses were found.

May 9 – 10, 1959. Egg masses were commonly found during this period. These are easily distinguished from egg masses of *R. sylvatica* by their loose structure, which is unlike the compact globular mass of *sylvatica*. They are usually laid in slightly shallower water than those of *R. sylvatica*. Calling was noted both days, with a particularly strong chorus on May 10 at Roseneath, Kings County.

This species is common to abundant throughout the Island. Its peak breeding period occurs slightly later than that of *R. sylvatica* and corresponds with, or is slightly later than, that of *Hyla crucifer*. Although no transforming individuals were found, the abundance of young frogs at midsummer and the comparatively early breeding season — early in May — seem to indicate that overwintering of tadpoles does not occur.

SPECIMENS EXAMINED

PRINCE COUNTY. 2523. Kinkora, June 25, 1953 (1); 2524. Alberton, June 27, 1953 (1); 2525. Kensington, June 25, 1953 (2); 2714. Ellerslie Pond, June 17, 1953 (2); 3619. 1.9 mi. w. of Miscouchee, June 19, 1958 (4); 3782. Springfield West, July 9, 1958 (1); 3786. 1 $\frac{3}{8}$ mi. e. of Glenwood, July 9, 1958 (4); 3941. 1.5 to 1.8 mi. s. of Grand River, April 24, 1959 (2). QUEENS COUNTY. 3613. Simpson's Pond, Hunter River, June 17, 1958 (1); 3614. Stanley Bridge, June 17, 1958 (22); 3630. Harrington, June 19, 1958 (1); 3641. 1.8 mi. w. on Hwy. 3 of Millview, June 23, 1958 (1); 3662. Hunter River, June 26, 1958 (1); 3664. 0.7 mi. se. of Millvale, June 26, 1958 (1); 3667. 1.5 mi. e. of Borden, June 28, 1958 (8); 3670. 0.4 mi. sw. on Hwy. 19 of New Dominion, June 28, 1958 (1); 3677. Fairview (School), June 28, 1958 (8); 3680. 0.8 mi. e. on Hwy. 19 of Fairview (School), June 28, 1958 (8); 3683. Rocky Point, June 28, 1958 (3); 3690. Granville, July 1, 1958 (12); 3745. 1.7 mi. ne. of Oyster Bed Bridge P. O., July 6, 1958 (1); 3978. Victoria Park, Charlottetown, May 10, 1959 (1); 3953. 3.9 mi. e. on Hwy. 2&3 via new road from Charlottetown (bridge), April 25, 1959 (5); 3983. YMCA Camp, 1.2 mi. s. of Rocky Point, May 10, 1959 (2). KINGS COUNTY. 2519. Georgetown, June 17, 1953 (6); 2520. Georgetown, June 18, 1953 (4); 2521. Georgetown, June 19, 1953 (7); 2522. Bay Fortune, June 20, 1953 (8); 3717. Roseneath, July 4, 1958 (1); 3725. 0.6 mi. e. of Roseneath, July 4, 1958 (7); 3760. Boughton River millpond, 2.2 mi. n. of Dundas, July 7, 1958 (1); 3956. 3.3 mi. sw. on Hwy. 5 of Bridgetown, April 26, 1959 (1); 3963. 0.6 mi. e. of Roseneath, April 26, 1959 (4); 3969. 0.6 mi. e. of Roseneath, May 9, 1959 (3).

LITERATURE RECORDS

This is almost certainly the species Bain (1890) referred to: "Green and bronze-coloured Frogs are found in damp grass fields." Cox (1899a) noted its occurrence on Prince Edward Island under the form *R. virescens virescens* Kalm but commented that the form *R. virescens brachycephala* Cope was not observed by him nor by Roy McLean Vanwart. Cox (1899b) noted that (as *Rana virescens*) it occurred throughout the Maritime Provinces, and in a subsequent paper (1899c) he commented that it was less abundant on Prince Edward Island than in the coastal region of New Brunswick. Hurst (1944)

listed it as "common" on the Island. Logier (1952) included Prince Edward Island in his range statement. Logier and Toner (1955) gave "Prince Co., Lot 16 (ROMZP)," and in a subsequent revision added "Kings Co., Souris (ROM)." Bleakney (1954) noted that it was found on the 1953 expedition and (1958) mapped a locality from Queens County based on literature records and localities in Prince and Kings counties based on National Museum records.

Storeria occipitomaculata occipitomaculata (Storer)

Northern Red-bellied Snake



FIGURE 25—Red-bellied Snake. *Storeria o. occipitomaculata*. NMC 2699. Male. Approximate total length $7\frac{3}{4}$ inches (after preservation).

VARIATION

Seven specimens, all males, were examined.

Length. The largest preserved specimen measured 214 mm in total length.

Scalation. Dorsal scale rows were 15-15-15 in all specimens. Supralabials were 6/5 (1) and 6/6 (6); infralabials 6/5 (1), 6/6 (2), 6/7 (1), and 7/7 (3). Preoculars were 2/2 in all specimens; postoculars 1/2 (1), 2/2 (6). Ventrals were 115 (1), 117 (1), 118 (4), and 119 (1); subcaudals 46 (1), 47 (1), 48 (1), 49 (1), and 51 (1) in five specimens with complete tails.

Colour and pattern. Three dorsal colour phases—grey, black, and tan—may have been represented by these specimens, but all had faded in preservative making these distinctions uncertain. The three typically distinct neck spots were present. The venter was orange-red in life (PC: M.L.H. Thomas).

COMPARISON

Bleakney (1952) recorded 118 to 123 ventrals and 51 to 52 subcaudals for Nova Scotia males. The Prince Edward Island specimens seem to have lower counts in comparison, 115 to 119 ventrals and 46 to 51 subcaudals, but the apparent difference in ventral count may be due to the use here of the Dowling (1951a) system whereas Bleakney followed Schmidt and Davis (1941).

FIELD NOTES

No specimens were seen during the survey, although verbal reports of the species were received.

SPECIMENS EXAMINED

PRINCE COUNTY. ROM 7435* "Fisheries Research Laboratory" [Enmore] (1); 8283. Tyne Valley, September 7, 1964 (1); 8286. Murray Road, September 26, 1964 (4). QUEENS COUNTY. 2699. Belle River, October, 1953 (1).

LITERATURE RECORDS

Melish (1876) noted that it was "numerous [on Prince Edward Island] . . . of a dusky brick colour, the belly being of a lighter shade than the back." Cox (1903) remarked that it "is distributed sparingly in all the maritime provinces" Logier (1939) and Mills (1948) both included Prince Edward Island in their range summaries. Logier and Toner (1955) cited a Royal Ontario Museum specimen from Enmore, Prince County, and in their revision (1961) they repeated Enmore and added "Charlottetown (Melish, 1878 [=1876] p. 164)." Bleakney (1958) mapped it as occurring in Prince and Queens counties on the basis of literature records.

Thomas (1965) reported five specimens collected in Prince County which have subsequently been donated to the National Museum of Canada and are included in the specimens examined in this report. One of his specimens was found in a dry ditch bordering farm land and the other four in a trench cut from a drain which served as a pit trap. The latter site was in open, mixed woodland. He noted that they must be considered common in the area.

Thamnophis sirtalis pallidula Allen†

Maritime Garter Snake

VARIATION

Thirty-one specimens were examined, 22 females and 9 males.

Length. Three specimens taken in 1953 and 1958 and measured before preservation had total lengths of 676 mm (male), 737 and 787 mm (females). Eleven 1965 specimens measured by Thomas had total lengths of 401 to 587 mm (4 males) and 591 to 919 mm (7 females).

Scalation. The dorsal scale row counts were 19-19-17 in 22 specimens, and 17-19-17 (5), 17-17-17 (1), 17-17-15 (3) in the remaining seven. Expanded by additional counts the atypical counts were 19-17-19-19-17-17, 19-17-19-17-17-17, 19-17-19-17-17-15 respectively (original standard count positions indicated by italics).

The dorsal scale row variation and position of loss or addition of rows were tabulated for the 27 National Museum specimens (including all nine atypical specimens) in detail using the method presented by Dowling (1952b).

*Royal Ontario Museum specimen.

†The International Commission on Zoological Nomenclature has ruled that *Coluber sirtalis* Linnaeus 1758 be interpreted from the description and type-locality given by Harlan 1827 (Opinion 771. *Thamnophis sirtalis* Linnaeus 1758 (Reptilia): Rejection under the plenary powers of the neotype specimen designated for that species by Opinion 385. Bulletin of Zoological Nomenclature 23 (1): 38-40. 1966). Because of this decision, the use of *Thamnophis sirtalis pallidula* as the name for the Maritime Garter Snake (by those workers maintaining its distinctness as a subspecies) is validated. *Thamnophis sirtalis sirtalis* is the correct name for the Eastern Garter Snake.



FIGURE 26—Maritime Garter Snake, *Thamnophis sirtalis pallidula*. NMC 3783. Male. Total length 26 $\frac{5}{8}$ inches. This is the specimen with an orange dorsal stripe described in the text. In most specimens the pattern does not show so much contrast.

In 23 specimens the scale row count immediately behind the head was 21, but this was reduced to 19 by the loss of two rows between (opposite) ventrals 3 to 7. In two of these cases the initial count was 23, but in both it reduced to 21 opposite the third ventral. One specimen had an unsymmetrical count of 20; the loss of a row on the left brought the count to 19 opposite the sixth ventral. Three specimens were 19 initially. In standard counting the initial count, which is made an inch or so behind the head, would be beyond ventral 7, the furthest a count of 21 extended.

In the 18 National Museum specimens examined that had a standard count of 19-19-17, the reduction in scale rows occurred past midbody, opposite ventrals 69 and 84. In three the rows were lost, resumed again, and lost between ventrals 69 and 74. In one a row on the right was lost and was gained again between ventrals 121 and 124.

In five specimens with a standard count of 17-19-17 a reduction from 19 to 17 rows occurred between ventrals 7 and 15; the lost rows were regained between ventrals 14 and 33 (in one specimen the two rows were gained-lost-gained between ventrals 16 and 21; in another they were gained-lost-gained from ventrals 23 to 44 on the right side and 23 to 28 on the left). In all these specimens the final reduction from 19 to 17 rows was past the midbody point, between ventrals 72 and 82.

One specimen had a standard count of 17-17-17. The reduction from 19 to 17 occurred opposite ventral 8, and the restoration to 19 was opposite ventrals 23 and 24. The final reduction to 17 occurred before midbody at ventrals 61 to 65.

Three specimens had a standard count of 17-17-15. The reduction from 19 to 17 was opposite ventrals 7 to 10, and the restoration to 17 was between ventrals 18 and 33 (one specimen had a gain-loss-gain several times on the left side between ventrals 18 and 81). The final reduction to 19 occurred between 61 and 69 in two, and 44 and 81 in one (the same aberrant specimen noted above). In these specimens there was a further reduction to 15 scale rows opposite ventrals 92 to 119, but in only one was the 15 count kept consistently for the remainder of the length. In the other two the count fluctuated between 15 and 17 until the end of the body.

The reduction in the number of scale rows was through the loss of a row or the fusion of two rows. The latter condition was indicated by the presence of two keels on the first scale of the single row following the loss of a row (Rutheven, 1908: 17). The reduction from 23 rows was through the loss of the fifth row in one snake, the fourth in the other. The reduction from 21 rows is usually through the loss of the fourth row, occasionally through the loss of the fifth or the third or the union of the fourth and fifth or third and fourth. In the anterior reduction from 19 the loss appears usually to be of the fourth row, rarely the third, and occasionally through the union of the third and fourth or rarely the second and third. The anterior gain to 19 is always through the addition of the fourth row. The reduction from 19 near midbody is nearly always through the loss of the fourth row, very rarely through union of third and fourth rows. The reduction to 15 is through the loss of the fourth or rarely of the third row or often the union of third and fourth. Restoration to 17 is by the gain of the fourth row or rarely the third.

Preoculars were 1/1 in all specimens; postoculars were 2/2 (1), 2/3 (1), 3/2 (2), and 3/3 (27). Supralabials were 6/7 (1), 7/6 (1), 7/7 (27), 7/8 (1), and 8/7 (1); infralabials were 8/7 (1), 9/9 (2), 9/10 (4), 10/9 (1), 10/10 (22), and 10/11 (1). The ventral scale counts were 142 (1), 144 (1), 145 (1), 146 (1), 147 (1), 148 (1), 149 (1), 150 (1), and 153 (1) for males; 137 (1), 138 (1), 139 (3), 140 (3), 141 (3), 142 (3), 143 (2), 144 (3), 145 (2), and 146 (1) for females. Subcaudal counts for specimens with complete tails were 63 (1), 64 (1), 65 (1), 66 (1), 68 (1), 69 (1), and 73 (1) for males; 52 (1), 54 (1), 55 (2), 57 (3), 58 (2), 59 (5), 60 (2), 61 (1), 62 (2), and 64 (1) for females.

Colour and pattern. Only two specimens were seen in life, and most specimens faded and darkened in preservative to such an extent that the colours in life were largely lost. However, besides the two specimens mentioned above, colour slides of sixteen others have been seen (these provided by M.L.H. Thomas, of the snakes collected in 1965), and a general description is possible.

Garter snakes on Prince Edward Island were brown, olive, or grey in ground colour, usually with three light stripes and always with two rows of dark brown or black rectangular spots alternating on the ground colour between the stripes in a checkerboard pattern. These spots are most prominent on specimens which have a light ground colour, but the ground colour is never dark enough to obscure their pattern. The light areas on the skin between the spots, visible when the skin is spread, were usually whitish, but in two specimens they were distinctly reddish anteriorly. The lateral stripes were prominent on all specimens but one, on which they were obscure or

lacking (this specimen also lacked a dorsal stripe which left it a brown-checked atypical appearance). These stripes are generally yellowish in colour but may be very pale, almost white, dull, slightly greenish, or lemon-yellow. They were well defined from the ground colour above, but their edges tended to merge with the ground colour below and to be indistinct. Generally the dorsal stripe, when present, was paler than the lateral stripes, most often whitish, greenish yellow, or grey. In one specimen, however, this stripe was orange in life (NMC 3783); another (ROM 7434) apparently had the same dorsal stripe colour as indicated by some traces of orange remaining in this position in the preserved specimen (*see* Comparison, below). In many specimens the stripe was obscure or absent throughout or absent for the latter two-thirds of the body. In a few of these snakes this obscurity was enhanced by the upper rows of the checkered pattern approaching or meeting across the back. Although fading in preservative makes determinations of the prominence of the dorsal stripe uncertain, ten snakes appeared to have had a prominent dorsal stripe, and nine probably lacked this stripe or had it largely obscured. In the remaining eleven snakes in the sample the dorsal stripe was at least practically obscured or lacking on the posterior part of the body.

The underside was lighter anteriorly and darker posteriorly: buff to yellow grading to buff olive green, bluish green, or metallic grey from the throat to the anal plate respectively.

Some variations in colour of specimens (darker ground colour, paler stripes and undersides) were, of course, present in snakes about to shed their skins. Colours are always brighter immediately after shedding.

COMPARISON

Bleakney (1959) redescribed *Thamnophis sirtalis pallidula* after a critical study of material from Eastern Canada. In scale counts, all Prince Edward Island specimens fell within the range of variation given. Seventy-four females from Eastern Canada had 137 to 149 ventrals; fifty-five males had 143 to 154. Island specimens are within this variation with 137 to 146 for females and 142 to 153 for males. Subcaudal counts for specimens with complete tails given by Bleakney, females 53 to 69, males 61 to 77, essentially encompass the Prince Edward Island variation of 52 to 64 for females and 63 to 73 for males.

Bleakney based the valid subspecific standing of *pallidula* on the general darkness of overall appearance and the conspicuousness of spots in all maritime specimens. He found that two-thirds of his sample lacked a dorsal stripe or had only an incomplete one. In the other one-third the stripe was light grey. Twenty-nine of the Prince Edward Island sample seemed to fit within this colour variation, although stripes often appeared to feature more yellow than he described. Two specimens were exceptional. The orange dorsal stripe in one and the likelihood of an identical pattern in another set these specimens apart from other Maritime Garter Snakes. Both, however, had the prominent lateral spotting of *pallidula*. It is possible that the phase with the orange dorsal stripe may be restricted, within the range of *pallidula*, to this Island. No other

Canadian specimens with orange stripes have been reported east of those noted by Bleakney (1959) from Montreal and northeastern Ontario's Abitibi and James Bay areas. The possible uniqueness of the Prince Edward Island population owing to the occurrence of this phase does not detract from the apparent validity of *pallidula* as a subspecies.

A paper by Cox (1903), unknown to Bleakney (1958, 1959), gave a wide range of variation for colour pattern for Maritime Garter Snakes, including red bars on the sides not unlike *T. s. parietalis*. Two specimens taken by Thomas in 1965 in Prince County, which show red on the skin between the scales anteriorly, probably represent the condition seen by Cox.

The dorsal scale reductions and abnormal counts in seven specimens contrast markedly with the findings of Rutheven (1908), who pointed out the regularity in the row that was lost to reduce the number of rows in the genus *Thamnophis* (op. cit. p. 16ff.) and the consistency of the 19-17 count (op. cit. p. 176, 181). He found only two specimens out of 600 examined that varied from this dorsal count, and these (both from Florida) had formulae of 19-21-19-17. Since the variation dorsal row formula is not usually examined in the detail presented here, only future studies will show if the slight trend toward reduction in rows exhibited by Prince Edward Island specimens is unique.

Perhaps it should be noted, in connection with the status of *T. s. pallidula*, that Rutheven (1908: 184), in discussing this form and rejecting it, seemed to have combined, at least in print, the description Allen (1899: 64 – 66) gave of *pallidula* and the translation the latter gave for the original description of *sirtalis* by Linnaeus, particularly as to the colour of the stripes.

FIELD NOTES

June 16 – July 10, 1958. One specimen was collected June 23, 1.6 miles east on Hwy. 2 of Hazelbrook, Queens County, from a brush pile at the edge of a pond. Another was taken July 9 from under a board at the edge of the millsite at Glenwood. One cast skin (NMC 3742) was found July 4, 3.3 miles southwest on Hwy. 5 of Bridgetown, Kings County, under a board at the edge of a gravel quarry rubbish heap. A second (NMC 3754) was discovered under a piece of tin at the same locality July 7. A dead specimen, recently killed by campers, was seen at the Boughton River millpond, 2.2 miles north of Dundas, Kings County, July 7, but was too mangled to preserve. One other snake was reported observed in this area on the same day.

Verbal reports indicate that the species is sometimes seen on the golf course at Cavendish and at the YMCA Camp at Rocky Point, both in Queens County.

April 24 – 26, May 9 – 10, 1959. No snakes were observed during the spring's collecting trips.

This species is generally common in much of Nova Scotia and New Brunswick; it may be rarer on Prince Edward Island.

SPECIMENS EXAMINED

PRINCE COUNTY. 3783. Glenwood, July 9, 1958 (1); ROM 4709. Grand River (Lot 16), October 3, 1935 (1); ROM 7434. Malpeque Bay, August 28, 1945 (1); 8278. Murray Road, May 19, 1964 (1); 8279. Murray Road, May 30, 1964 (1); 8280. Black Banks, June 10, 1964 (1); Murray Road, August 23, 1964 (1); 8284. Tyne Valley, September 10, 1964 (1); 8285. East Bideford, September 26, 1964; 9119. Tyne Valley, May 8, 1965 (1); 9120. Murray Road, May 17, 1965 (1); 9121. Ellerslie Brook, June 8, 1965 (1); 9122. Port Hill Station, June 20, 1965 (1); 9123. Port Hill Station, June 27, 1965 (3); 9124. Port Hill Station, July 3, 1965 (2); 9125. Enmore, August 5, 1965; 9126. Black Banks, August 19, 1965; 9127. Enmore, August 29, 1965 (1); 9128. Tyne Valley, August 27, 1965 (1); 9129. Murray Road, September 3, 1965 (1); 9130. Tyne Valley, September 6, 1965; 9131. Tyne Valley, September 23, 1965. QUEENS COUNTY. 2535. Hunter River, June 25, 1953 (1); 3635. 1.6 mi. e. on Hwy. 2 of Hazelbrook, June 23, 1958 (1); 2213. 10 mi. w. of Souris, June 9, 1952 (1); 2214. Rollo Bay, August 1, 1952 (1); ROM 9211-9212. Near Souris, August 1, 1915 (2).

LITERATURE RECORDS

Mellish's (1876) remarks are of interest as he is the first authority to report its occurrence on Prince Edward Island, but his large size record, at least, probably is exaggerated since it exceeds any recorded for the species. He stated under "*Eutaenia Sirtalis*": "... found on the Island in large numbers. It seems to attain to a much greater size than in Nova Scotia. I have frequently seen them from 2½ feet to 3½ feet in length; and from 2½ inches to 5 inches in circumference at the thickest part. I think the colour too is generally darker than that of the Nova Scotia Garter Snake, although in some cases the belly is nearly white . . . The largest I have seen measured was 4 feet 9 inches in length, and was 4½ inches in circumference . . . These snakes have frequently been seen swimming across the Hillsboro, near Charlottetown, where the river is over a mile in width."

Bain (1890) remarked that it is the common snake on the Island. Cox (1899b, 1899c, 1907) listed the species for the Maritime Provinces but did not specifically include Prince Edward Island. Logier and Toner (1955, 1961) gave "Charlottetown (Mellish, 1878 [= 1876] p. 165)" and Conway, Prince County, based on a Royal Ontario Museum specimen. Bleakney (1958) mapped only one National Museum specimen from Queens County.

Thomas (1965) reported the collection of six specimens from Prince County in 1964 which have subsequently been deposited in the National Museum of Canada and are included in the specimens examined in this paper. He commented that this species is very common in his area (Prince County) and that many were seen throughout the summer of 1964 on hot days. His specimens were taken in a dry ditch bordering farm land and on roads through coniferous forest, in farm land, and bordering an area of mixed woodland and peat bog. Specimens taken by Thomas in 1965 were from similar habitats (PC: M. L. H. Thomas).

Opheodrys vernalis vernalis (Harlan)

Eastern Smooth Green Snake

VARIATION

Four specimens, reported by Martin L. H. Thomas (1965) and subsequently donated to the National Museum of Canada, have been examined. These are the first, and to date the only, specimens of this species collected on the Island. All are females.

Length. No specimens were measured before preservation. The largest of the preserved specimens measured approximately 432 mm, total length.

Scalation. The dorsal scale rows were 15-15-15 in each of the four specimens. The infralabial counts were 7/7 in all specimens, but supralabial counts were 7/7 (1), 8/8 (2), and 7/8 (1). Preoculars were 1/2 (1), 2/2 (1), 2/1 (1), and 1/1 (1); postoculars were 2/2 in all four. Ventral counts were 123, 125, 129, 131, and subcaudal counts were 63, 64, 68, and 70.

Colour and pattern. Coloration in these specimens was apparently the normal for the species, grass green above (PC: M. L. H. Thomas) and white beneath.

COMPARISON

Bleakney (1952) recorded only one female from Nova Scotia. It had 136 ventrals and 72 subcaudals; both counts are higher than the counts for P.E.I. specimens, the highest of which are 131 and 70 (in different specimens).

FIELD NOTES

The Smooth Green Snake was not observed during field studies in 1953, 1958, or 1959; however, several reliable verbal reports described this small green snake.

SPECIMENS EXAMINED

PRINCE COUNTY. 8281. Murray Road, July 15, 1964 (1); 8287. Murray Road, September 27, 1964 (3).

LITERATURE RECORDS

Mellish (1876) stated that "The Green Snake (*Chlorosoma vernalis*) so common on the continent is entirely unknown . . ." but appended a footnote: "Since this Paper was read I have learned from James L. Mellish, Esq. of Pownal, P.E.I., that the *chlorosoma vernalis* was sometimes to be seen on the Island forty or fifty years ago."

Bain (1890) mentioned the Green Snake as rare. Logier and Toner (1955, 1961) did not include any Prince Edward Island records. Bleakney (1958) mapped one locality in Kings County, based on a verbal report.

Thomas (1965), who reported the first specimens to be preserved, recorded the habitat as a road in coniferous woodland for one specimen and a trench cut for a drain which served as a pit trap in an area of mixed open woodland for the remaining three.

Rejected Records

Four species recorded from Prince Edward Island by previous authors are omitted from the 'Species Accounts' section. In each case a reasonable doubt exists as to the accuracy of the identification, and no specimens have been located in museum collections to substantiate their inclusion. None of these species were observed during the field studies of 1953, 1958, and 1959.

Rana palustris Le Conte — Pickerel Frog

Cox (1899a) first reported this species from Prince Edward Island. He commented: "Roy McLean Vanwart and the writer found it very rare in P.E. Island . . . P. E. Island specimens show more palmation with white line along edge of upper jaw extending forward to the nostril." Cox subsequently (1899b, 1899c) repeated that it was found on Prince Edward Island.

As Cox did not mention any specimens with brown rather than green ground colour in his account of *Rana virescens* (= *R. pipiens*) it is possible that he may have confused this colour phase with *Rana palustris*, particularly as he notes that they are different from New Brunswick specimens. Brown *R. pipiens* were found on the Island by the writer. In addition, Cox omits any reference to the characteristic orange of the underside of the hind legs in *R. palustris*.

Hurst (1944) included *R. palustris* in his list of amphibia of the province. A search of his notebooks, which were kindly made available by his son, Blythe Hurst, Jr., in 1958, revealed only two handwritten lists of the species of the province. These were probably preliminary lists based on the available literature. Beside *Rana palustris* is the notation "P.E.I. according to Cox (Phillip) 1899" on one list, and "(Cox 1899!)" on the other. Hurst's paper gives an excellent description of *R. palustris*, which included the orange on the underside of the hind legs. This description was likely compiled from the literature, as there is no evidence that Hurst had actually seen or collected any specimens.

Logier (1952) included Prince Edward Island in his range statement, and Logier and Toner (1955, 1961) cited a reference to Cox (1899c) as the only record. Bleakney (1958) plotted a literature record in Queens County. He noted in his text (p. 16) that this species "has been listed from this island by Cox (1899) and Hurst (1944), and although no specimens are available to confirm this, the paucity of collecting done on the island makes it impossible to deny their statements."

Hurst, like subsequent authors, seems to have included the species solely on the authority of Cox, and the latter's identification is open to some doubt. At the time Bleakney's paper was written, only a few days (in 1953) had been spent in systematic collecting on the Island, but during field trips in

1958 and 1959 all types of habitat were sampled without discovering the Pickerel Frog. Evidence sufficiently indisputable to warrant its inclusion as part of the herpetofauna of Prince Edward Island is lacking.

Rana septentrionalis Baird — Mink Frog

Cox (1899a) stated, "Roy Vanwart and the writer did not observe it on P.E. Island," and later reiterated "nor does it occur on P.E. Island" (Cox 1899b) and "Does not occur on P.E. Island" (Cox 1899c). Confusingly, owing to a manuscript or typesetting error in the last paper, he stated under a subsequent species, *Rana fontinalis* (= *R. clamitans*): "Its place is taken by *R. septentrionalis* in Gaspé, New Brunswick and Prince Edward Island." It is evident by comparing the text in this paper with those of the first two that this statement was meant to refer to Gaspé but not to New Brunswick or Prince Edward Island. Fortunately no subsequent authors have included the species from Prince Edward Island on the basis of Cox's statement.

Fowler (1915) identified as *Rana septentrionalis* four collections taken "from Black Point, between Southport and Lake Verde, Tignish and from large swamp in Dundee . . ." James E. Böhlke of the Department of Ichthyology and Herpetology, Academy of Natural Sciences of Philadelphia, kindly loaned the collections from one of these localities: ANSP 18765, ANSP 18766, Dundee, Prince Edward Island, Canada, collected by B. Long, August 26, 1912. Both specimens are juvenile *Rana clamitans*. They measure 36 and 30 mm in snout-vent length, and the smaller individual has a 6 mm tail stub. None of the other collections reported as *R. septentrionalis* by Fowler can be located (PC: J. E. Böhlke, January 10, 1961). It seems likely, however, that they also were misidentifications of *R. clamitans*, particularly as no individuals of this common Prince Edward Island species were reported in Fowler's paper.

Logier (1952) included Prince Edward Island in his range statement, although the species was omitted in the list by Hurst (1944). Logier and Toner (1955, 1961) cited: "Kings Co. Dundee (Fowler 1915, p. 518)." Bleakney (1958) plotted one literature locality in Prince Edward Island, which is cited in the text (p. 16) as coming from Fowler's paper.

All literature records, therefore, have been based on Fowler's (1915) misidentifications, and there are no known specimens of *Rana septentrionalis* from Prince Edward Island. This species was searched for diligently in 1958, and all ponds that might have been suitable habitat were surveyed from a distance with binoculars before any visible frogs were disturbed. No Mink Frogs were seen. The habitat requirements for *R. septentrionalis* have not been thoroughly investigated, but in Eastern Canada they seem to prefer the permanent water of lily-pad-choked ponds, lakes, or quiet bays of rivers. Only a few of the man-made millponds approach these conditions, and it is probable that these do not provide the species' requirements.

Coluber constrictor constrictor Linnaeus — Northern Black Racer

This species is the will-o'-the-wisp of herpetology in the Maritime Provinces of Canada. Bleakney (1958, p. 18) has discussed the evidence of its

occurrence in this region. It is often reported, but no specimen with locality data from the Maritimes exists in a museum collection.

Mellish (1876) recorded it from Prince Edward Island under "*Bascanion Constrictor*" as follows: "... not as rare on the Island as it is in Nova Scotia. Dr. Thomas Dawson, of Charlottetown, informed me that he once found four together in the woods It is generally much smaller than the Garter Snake although in a few cases I have known them to exceed three feet in length." This report was cited by Logier and Toner (1955, 1961) as their only Prince Edward Island record and was plotted by Bleakney (1958). However, it seems to this writer to convey nothing in its content to convince anyone except Mellish of its validity. It could refer to dark-coloured garter snakes and/or (for the small examples) to the dark phase of the Red-bellied Snake. Mellish mentioned only the reddish or tan phase of the latter species in his account of it, although both this and the dark phase occur on the Island. Bain (1890) included the "*Blacksnake*" in his list and commented that it is smaller than the garter snake, a statement likely gleaned from Mellish's paper. Cox (1903) wrote: "The writer did not find it on Prince Edward Island, though popularly reputed to occur"

Certainly it is no problem to elicit verbal reports of 'black snakes' in the province. Bleakney's (1958) record, plotted in Kings County by a symbol signifying a doubtful report, is based on verbal report. However, as no specimens were collected or seen during field studies, and as no verbal report was received that could be indisputably assigned to a racer, there does not seem to be a valid basis for including it with the Prince Edward Island species.

The same reasons for rejecting its occurrence on Prince Edward Island apply to the mainland. Despite verbal reports, no specimen has ever been collected and preserved in a museum. Most of the published reports for the mainland, like that of Mellish, fail to be convincing. The young of this species are spotted, and no spotted snakes have ever been reported in the Maritime Provinces. Lacking any indisputable evidence for its presence, it is best to omit it from Nova Scotia and New Brunswick lists as well, until such time as a specimen is collected.

"*Coluber lineatus*? Mellish — The Striped Snaked"

This name was given by Mellish (1876) for a species which he had seen, but apparently had not collected, on Prince Edward Island. His descriptive paragraph is quoted in full:

"I have frequently seen a small snake, striped with black, white and dark green. This I have not been able to identify; and I regard it as a new species. It is found in the grass and among bushes, but not in the vicinity of dwellings. I have not seen any of them as small as the smallest redbellied snake, nor yet any as large as the largest of the garter and black snakes. It is suggested that the name *Coluber lineatus* be given to this species provisionally, until it be more fully described."

Bain (1890) stated that the Striped Snake is rare. Undoubtedly he had read Mellish's paper, as no other reference to the 'species' is known.

The writer can but confess his own inability to assign this name with any hope of accuracy to any known species in Eastern Canada. The best guess, judging from several years of hearing verbal descriptions based on hasty impressions by casual observers, is that the snake seen was a garter snake in which the stripes were particularly well defined. In some Prince Edward Island specimens of *Thamnophis sirtalis* the stripes are strikingly more apparent at first glance than in any known to occur elsewhere in the Maritimes.

Zoogeography

Bleakney (1958) has discussed in detail the zoogeography of the reptiles and amphibians of Eastern Canada outlining limiting factors and postglacial dispersal patterns. He postulated that a land-bridge existed between New Brunswick and Prince Edward Island immediately after the last glacial retreat, about 16,000 to 10,000 years ago. A similar bridge was thought to have connected the Nova Scotia mainland and Cape Breton Island during the same period, and to have remained above water longer than the Prince Edward Island bridge. It was reasoned that, as the present salt-water straits which separate the Islands from the mainland constitute impassable barriers for amphibians and most reptiles, the species that now occur on these Islands must have reached them by these bridges. Species not represented were thought to have spread into the Maritime Provinces after the Islands were made inaccessible by the flooding of the bridges because of the rise in sea-level. Cameron (1958) also postulated land-bridges to account for the mammalian fauna of these Islands.

Since the publication of Bleakney's paper, comparatively little additional information on the Maritime herpetofauna has become available. The changes which pertain to a discussion of the zoogeography of Prince Edward Island may be summarized as follows:

1. Although Bleakney accepted the scattered published observations and verbal reports of *Coluber c. constrictor* in the Maritimes, further efforts to obtain specimens have failed. As discussed under 'Rejected Records,' evidence for its occurrence is inconclusive, and it should be deleted from the Maritime herpetofauna, thus reducing the total number of species to twenty-five.
2. *Rana septentrionalis* and *Rana palustris* were included by Bleakney for Prince Edward Island because insufficient field-work had been done to allow him to dispute the published records. However, subsequent field studies have failed to find specimens, and the published reports have been shown to be either in error or of doubtful validity (see 'Rejected Records'). The deletion of these species and *C. c. constrictor* reduces the Prince Edward Island total to twelve species.
3. *Ambystoma laterale* (referred to as *A. jeffersonianum* by Bleakney, 1958) has been reported from Cape Breton Island (Cook and Rick, 1963). This was the only species recorded from Prince Edward Island that was not also previously known on Cape Breton Island.
4. The ranges of *Eurycea bislineata* and *Desmognathus fuscus* have been extended to include southeastern New Brunswick up to the Isthmus of Chignecto, but neither species could be found on the Nova Scotia side of

the Isthmus (Cook and Bleakney, 1961). This substantiates the theory advanced by Bleakney (1958) that the Isthmus is a barrier to their dispersal.

5. The presence of *Opheodrys v. vernalis*, previously included in the Prince Edward Island herpetofauna on the basis of verbal reports, has been substantiated by the collection of four specimens by Thomas (1965).

Although Bleakney (1958) included Prince Edward Island in his discussion of the zoogeography of Eastern Canada, the new data above afford opportunity for a few supplemental remarks. For discussion, the Maritime herpetofauna may be conveniently divided into five groups each containing species with certain similarities in distribution.

GROUP 1. *Ambystoma laterale*
Ambystoma maculatum
Notophthalmus viridescens
Plethodon cinereus
Bufo americanus
Hyla crucifer
Rana clamitans
Rana sylvatica
Rana pipiens
Storeria occipitomaculata
Thamnophis sirtalis
Opheodrys vernalis

These species are the most generally abundant and widespread throughout the Maritime Provinces. All occur on both Prince Edward and Cape Breton islands. Although Bleakney (1958, p. 65) designated the amphibians in this group as 'common' in many of his Maritime divisions, this was perhaps a conservative view, and each may be regarded as abundant in most regions. An exception is *Ambystoma laterale* whose occurrence, in mainland Nova Scotia at least, is not well documented. It appears to have a scattered, non-continuous distribution. In many of Bleakney's Maritime divisions, the snakes of this group are designated as rare (Bleakney 1958, p. 66), a view which may also be slightly conservative, at least for some of the areas. This group contains all the Prince Edward Island herpetofauna. Its composition is good evidence that the Island was populated via a land-bridge, as the presence of *all* these widespread species seems to rule out chance dispersal, such as rafting, across the salt-water barrier. This fact, previously pointed out by Bleakney, remains valid despite the deletion of three species he considered to occur on the Island; one of these is rejected for the Maritimes as a whole (*C. c. constrictor*) and the other two (*R. palustris*, *R. septentrionalis*) are not so generally abundant and widespread as most members of this group.

GROUP 2. *Hemidactylium scutatum*
Rana palustris
Rana septentrionalis

These species have been recorded on the mainland and Cape Breton Island but do not occur on Prince Edward Island. *Hemidactylium* has not been

recorded from New Brunswick, but its widespread, although scattered, occurrence in Nova Scotia indicates that the apparent absence is due to insufficient collecting in suitable habitats.

All three are restricted within the Maritimes to some extent by habitat preference. Their absence from Prince Edward Island and presence on Cape Breton Island could be construed to mean that they had spread into the Maritimes after the submersion of the Prince Edward Island land-bridge, but before the flooding of the bridge to Cape Breton Island. If so, they must have started their northward spread much farther south, or moved north more slowly, than the species in Group 1. For *Rana septentrionalis* in particular, this is unlikely. At the present time its range extends almost as far north in Eastern Canada as the most northern species, *Rana sylvatica*. It seems most likely that it spent the glacial period near the southern limit of glaciation and was among the first amphibians to colonize the newly unglaciated areas when the ice withdrew. There seems to be no reason to suppose its spread north would have been any slower than that of *Rana sylvatica*, *R. pipiens*, or *R. clamitans*, all of which reached Prince Edward Island. However, *R. septentrionalis* seems restricted throughout its range to fairly large, permanent bodies of water which have a dense growth of water lilies. The habitats on Prince Edward Island nearest its requirements, which were examined during the survey, were millponds. Before the arrival of the European settlers the major amphibian habitats were likely temporarily flooded woods and low areas, small backwaters of streams, and a few small permanent ponds. None of these are suitable for *Rana septentrionalis*, although they would fill the requirements of all the known Prince Edward Island species. Additional habitat may have been available as beaver ponds. Cameron (1958) has cited evidence of beaver tooth-marks on sticks found in peat bogs, and Bain (1890, p. 118) remarked that beaver dams were still in evidence at the time he wrote. However, it is unlikely that the ponds created by this mammal were large enough or permanent enough to suit the requirements of *Rana septentrionalis*. The lack of suitable habitat is the best explanation for its absence from Prince Edward Island.

Hemidactylium scutatum is usually associated with sphagnum bog habitat, at least during egg laying and larval development. During the 1958 survey the bog areas examined were too dry to provide habitat for this species. Their condition may be due, at least in part, to drainage programs, and possibly these areas were formerly suitable. There seems no need to postulate the species' late arrival to account for its absence.

The one species in this group whose absence might best be explained by its late arrival is *Rana palustris*. There is no obvious lack of suitable habitat for it on Prince Edward Island. However, although widespread in the Maritimes, it does not occur in all apparently suitable habitats, nor is it usually abundant where it does occur, as are the frogs included in Group 1. Its habitat requirements and limiting factors are the least understood of any species in the Maritimes. Since its distribution pattern does not appear to correlate with temperature within this area, it is possible that it is limited by an as yet undetermined habitat preference. If so, this may also account for its absence from Prince Edward Island.

GROUP 3. *Eurycea bislineata*
Desmognathus fuscus

These two lungless salamanders have a marked preference for the margins of cool, rocky streams, and, in the case of *Eurycea*, of rivers as well. They are excluded from Nova Scotia, where apparently suitable habitat exists, because of the bogs and salt marshes of the Isthmus of Chignecto. Their required habitat is apparently lacking on Prince Edward Island where the streams and rivers are muddy and without rocky edges. Even if the Isthmus of Chignecto was also a barrier when a lower sea-level permitted the existence of the Prince Edward Island land-bridge, they probably would not have been able to colonize the Island owing to the absence of suitable habitat. If the Isthmus of Chignecto became a barrier only after the rise of the sea-level, these species must have spread to it after the sea-level rose, and therefore after the bridge to the Island was flooded; in this case the lack of suitable habitat has no bearing on their absence.

GROUP 4. *Rana catesbeiana*
Diadophis punctatus
*Clemmys insculpta**
Chrysemys picta
Chelydra serpentina

Temperature is probably the most important limiting factor for these species within the Maritime Provinces. With the possible exception of *Clemmys insculpta*, all are most abundant in Bleakney's Herpetofauna Section 2A (the Annapolis Valley and south-central Nova Scotia and the St. John River Valley—Grand Lake area in New Brunswick), which includes the maritime areas having the most moderate climate. All occur elsewhere in mainland Nova Scotia but are restricted to the warmer areas giving them a scattered non-continuous distribution. They are usually not abundant outside of Herpetofauna Section 2A. *Diadophis punctatus* and *Clemmys insculpta** probably tolerate lower summer temperatures since they are known from a few localities in northern New Brunswick. None of this group have been recorded for Cape Breton Island.

The absence of these species, particularly *Rana catesbeiana* and the turtles, Bleakney regarded as evidence that they had arrived in the Maritimes after the land-bridge to Prince Edward Island had been submerged. This may have been the case, but there are possible alternatives. Although the Environmental Temperature Indexes presented by Bleakney (1958, p. 39, 76) for Prince Edward Island are as high as or higher than in the mainland regions where these species have been recorded, they barely match those in Herpetofauna Section 2A where these species are abundant. Bleakney (1958, p. 39) has pointed out the limitations of this useful index. Especially important is that it does not necessarily represent the microclimate to which a species is restricted. Data on *Rana sylvatica* previously presented indicate that breeding may be a week later on Prince Edward Island than in Wolfville, N.S. (in Herpetofauna

*It now appears that habitat may be more important than temperature in limiting *Clemmys insculpta*. The distribution of this species with particular reference to Nova Scotia will be discussed in a paper by C. B. Powell currently in preparation, based on material presented in an Honours B.Sc. thesis accepted by Acadia University, 1965.

Section 2A). This would indicate a shorter period of herptile activity than shown by the Environmental Temperature Index figure, as *Rana sylvatica* is among the earliest amphibians to emerge from hibernation. Prince Edward Island has a fairly uniform climate, and there is no good evidence that the existing herptiles are any more successful or abundant in one portion than in any other because of a temperature difference. Therefore, there are no warm pockets where species at the limit of their temperature adaptation could survive during a succession of cold years. In such species, individuals which did not hibernate deeply enough would be killed, and/or successful reproduction would be prevented. Once the sea-level rose there would be no opportunity for repopulation from mainland warm pockets where these species could survive in years which were colder than normal. Known species from Prince Edward Island can all stand cooler temperatures than are normal for Prince Edward Island, as can be seen from comparing their distributions and the Environmental Temperature Indexes presented by Bleakney (1958). It seems possible that, although the herptiles from this group may have reached Prince Edward Island by the land-bridge, they could have been gradually eliminated by occasional years which were colder than normal. Data are needed on the species involved to determine their actual tolerances.

An additional, or alternative, factor which may have contributed to the absence of *Rana catesbeiana*, *Chrysemys picta*, and *Chelydra serpentina* is the absence of fairly large permanent ponds, as was discussed under *Rana septentrionalis*. This lack of habitat could have barred them from the Island if they were potential colonizers when the land-bridge existed.

GROUP 5. *Hyla versicolor*
Emydoidea blandingi
Thamnophis sauritus

These species are apparently relicts of a warmer postglacial period and are now restricted by the unfavourable temperatures which exist throughout the rest of the Maritimes. *Hyla versicolor* is known from only two localities in the vicinity of Fredericton in the St. John River Valley of New Brunswick. *Emydoidea blandingi* and *Thamnophis sauritus* occur only in a small area in south-central Nova Scotia. Even if the warm period during which they were able to occupy much of the Maritimes (or at least enough to leave the present relicts) coincided with the presence of the land-bridge to Prince Edward Island, any populations which had succeeded in colonizing the Island would have been eradicated by the subsequent decrease in temperatures, as they have been from all but the above restricted areas.

In conclusion, despite the deletion of three species which Bleakney (1958) had included in the Prince Edward Island herpetofauna, the twelve species now regarded as the total for the Island are still the commonest species occurring in the Maritimes. The land-bridge theory is substantiated as the most plausible explanation of their means of colonization. However, Bleakney's theory that the species which are absent from the Island arrived after the bridge was flooded is open to criticism. At present, both habitat and temperature factors cannot be overlooked as possible explanations of their absence.

Summary

This study of the reptiles and amphibians of Prince Edward Island is based primarily on collections and field notes obtained June 16 - July 10, 1958, and April 24-26 and May 9-10, 1959.

The Island herpetofauna is most interesting for its extensive reliance on man-made habitats: ditches, quarry ponds, and millponds and their dams.

Twelve species occur: *Ambystoma laterale*, *A. maculatum*, *Notophthalmus viridescens*, *Plethodon cinereus*, *Bufo americanus*, *Hyla crucifer*, *Rana clamitans*, *R. sylvatica*, *R. pipiens*, *Thamnophis sirtalis*, *Storeria occipitomaculata*, and *Opheodrys vernalis*. Large series of all the amphibians were collected during the field studies, and analyses of their variation, of data from field notes, and of comparisons with published studies are presented for each. The variation in 31 specimens of *Thamnophis sirtalis*, five *Storeria occipitomaculata*, and four *Opheodrys vernalis* is given, but two specimens of *Thamnophis* were the only snakes collected during the survey.

Three species, *Rana septentrionalis*, *Rana palustris*, and *Coluber constrictor*, recorded from Prince Edward Island by previous authors, are deleted from its herpetofauna because of possible misidentifications or insufficient evidence.

The zoogeography of Prince Edward Island is discussed by dividing the maritime herpetofauna into five groups whose included species have certain similarities in distribution. The twelve species which occur on the Island are the most widespread and generally abundant in the Maritimes. The hypothesis that these species reached the Island by a postglacial land-bridge is accepted. However, the lack of essential habitat or temperature requirements may account for the absence of some or all of the thirteen other mainland species, most of which have previously been considered to have spread into the Maritimes after the submergence of the land-bridge.

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